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C. F. JACOT-GUILLARMOD, ALBANY MUSEUM, GRAHAMSTOWN

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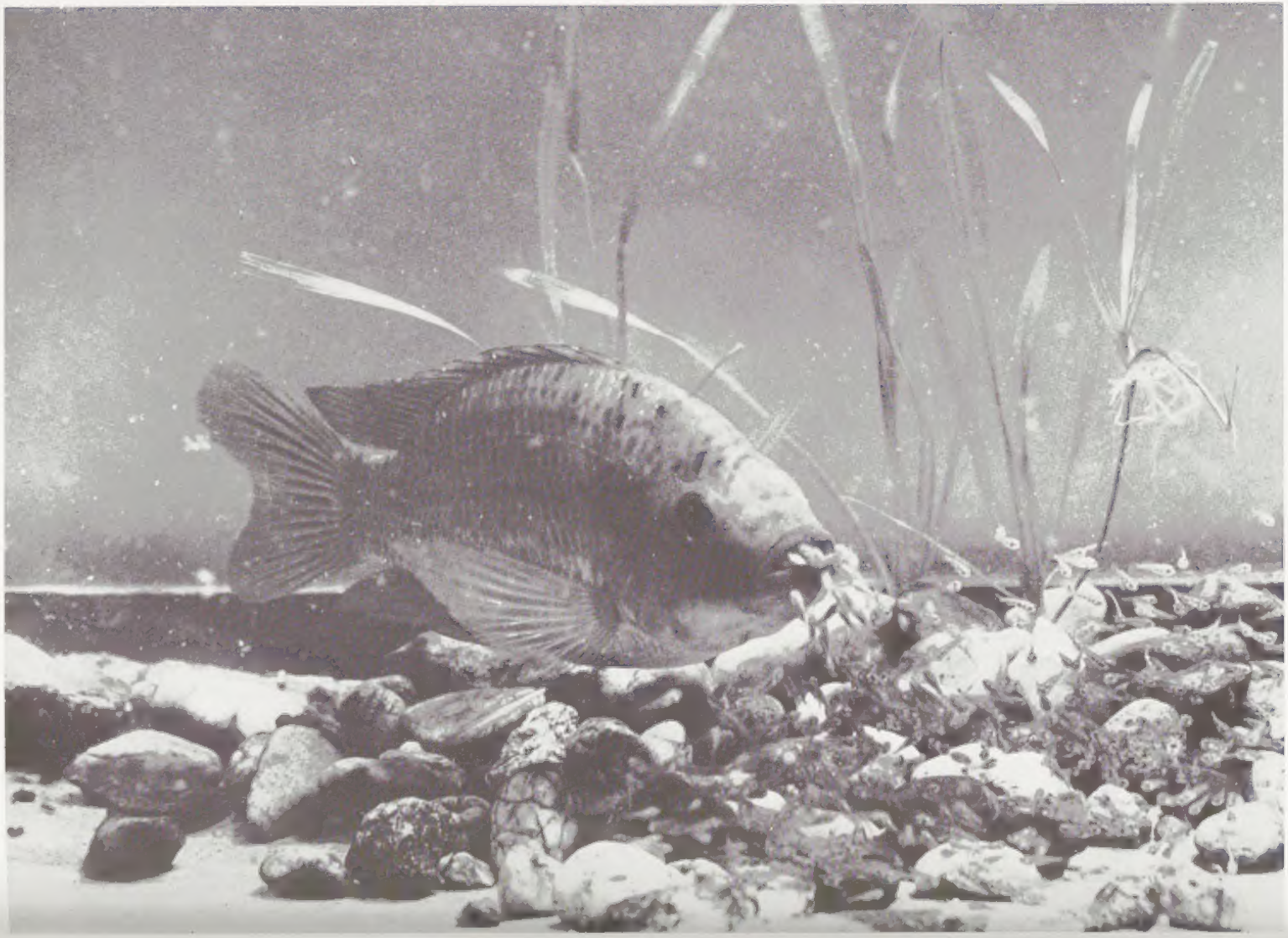

Young *Tilapia mossambica* entering the mouth of their mother. (F.A.O. photograph.)

FRESHWATER FISHES

OF THE

CAPE PROVINCE

by

R. A. JUBB

Albany Museum

Illustrated by H. M. Jubb

GRAHAMSTOWN

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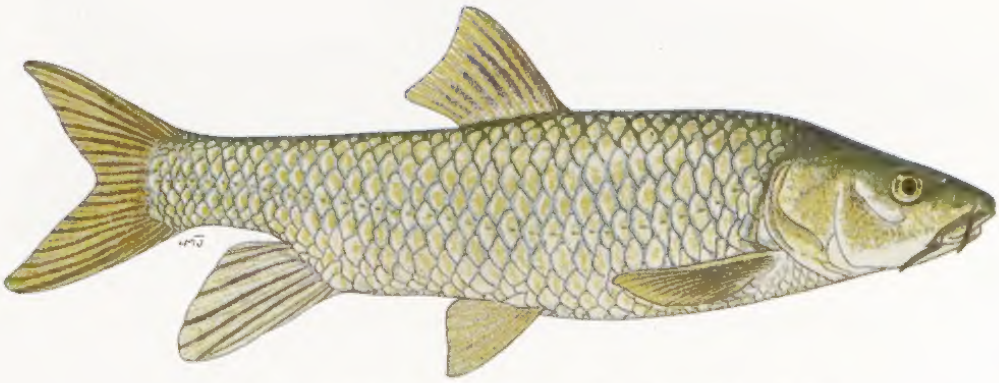

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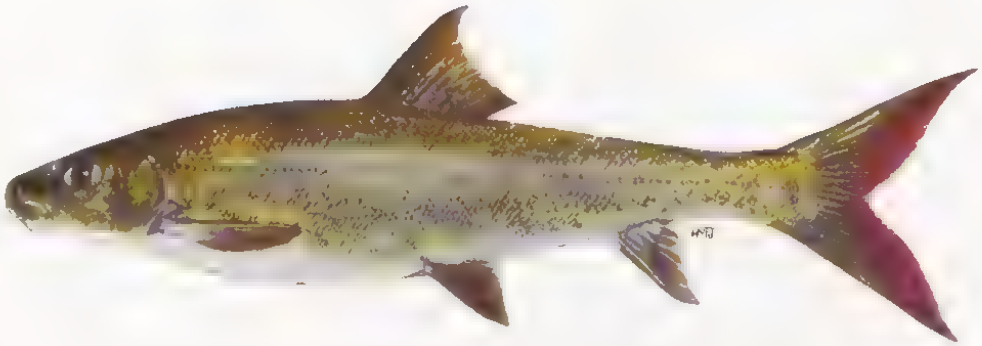

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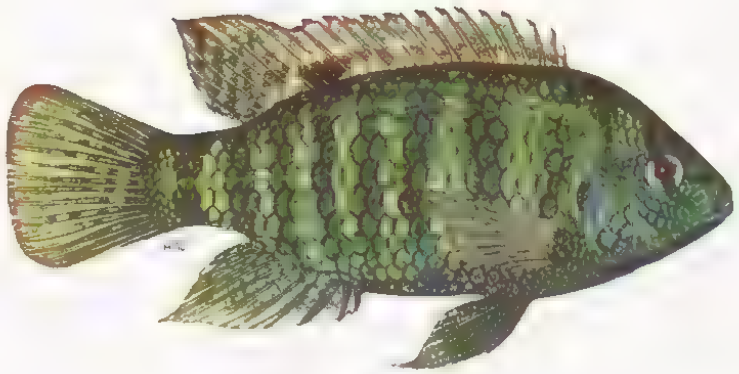

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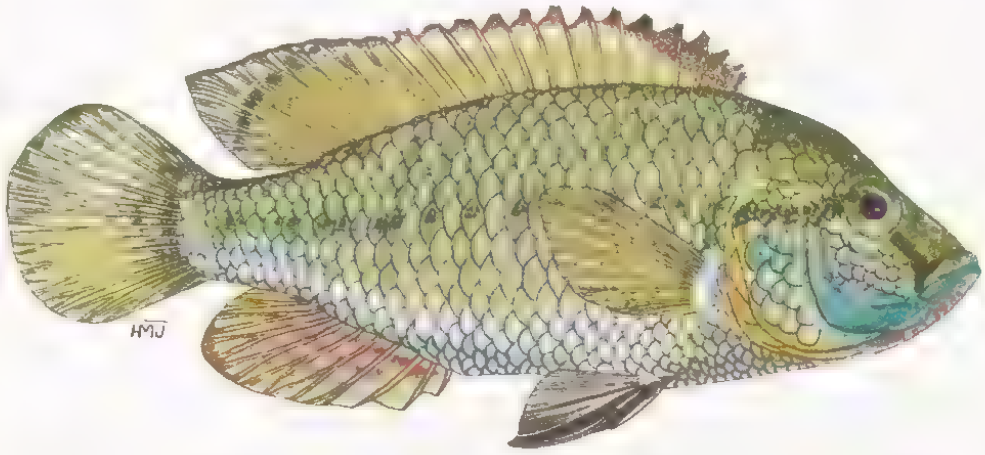

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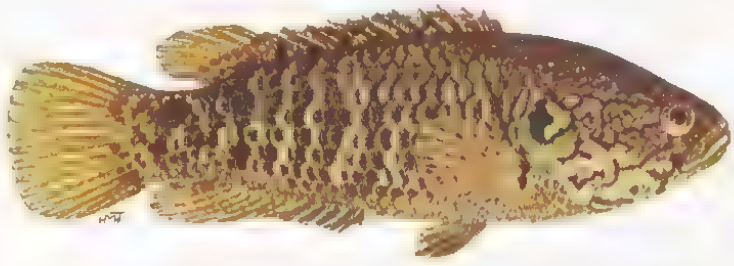

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INTRODUCTION

The Cape Province region embraces the South Coastal drainage basin, as described by Wellington (1955), Fig. 1, to as far north as the Umtamvuna River, which is the boundary with the province of Natal, and that portion of the Orange-Vaal system which forms part of the northern boundary of the province, or falls within it. Thus, in so far as the fish fauna is concerned, the freshwater fishes of two distinct drainage basins are involved, as well as those of the Umtamvuna River which happens to be the southern limit to the distribution of some Natal species.

The freshwater fishes of a portion of this region were described by Smith (1937) in his 'Freshwater fishes of the eastern Cape Province' published by the Albany Museum. The first taxonomical revision of certain fishes of the region appeared in 1943 when Barnard published his detailed paper 'Revision of indigenous freshwater fishes of the S.W. Cape region' which clarified most of the taxonomic confusion existing at that time. Since then, apart from the interesting articles by Harrison in *Piscator* which have contributed much to our knowledge of the natural history of some species, a paper on the *Anguilla* species (Jubb, 1961 (*a*)), and a paper on *Sandelia capensis* by Siegfried (1963), nothing has been written about the freshwater fishes of the South Coastal drainage basin. The Cyprinidae of the Orange River drainage basin have been dealt with by Groenewald (1958) and du Plessis (1963) and the Natal fishes by Crass (1960, 1964).

The present paper, printed by courtesy of the Department of Nature Conservation, now covers the whole Cape Province region and includes the results of the workers mentioned above, as well as research carried out at the Albany Museum. Not only was field and laboratory work sponsored by the C.S.I.R. Pretoria, but also the cost of sixteen sets of colour blocks of some of the illustrations kindly prepared by Mrs. H. M. Jubb. Other collaborators in this project will be mentioned in the text.

Fifty species are discussed in detail in the pages that follow. Of these nine are exotic species, some of which have become established, which are likely to be encountered. Those marine species which enter some fresh waters include *Gilchristella aestuarius* (Gilchrist & Thompson), Smith (1961) No. 108, *Monodactylus falciformis* Lacepede, Smith (1961) No. 580, the less common *M. argenteus* (Linnaeus), Smith, (1961) No. 581, and the freshwater springer or mullet, *Trachystoma euronotus* (A. Smith), Smith (1961) No. 890.

Some Physiographical Aspects

The watershed between the Orange and South Coastal drainage basins forms part of what is known as the Great Escarpment. The Orange River itself rises in the Basutoland highlands of the Southern African Highveld where altitude and seasonal melting snow provide conditions suitable for trout in many of the mountain tributaries. At lower altitudes the Orange River, now joined by the Vaal, continues westwards to the Atlantic Ocean through an arid region known as the Cape Middle Veld. This is a region of erratic and low annual rainfall, the southern tributaries of the Orange River being flood channels with little permanent water beyond that conserved for irrigation purposes. Of the northern tributaries the Molopo-Kuruman-Auob-Nossob system is now a relict drainage which carries water only on rare occasions when heavy rains occur in the area. Even when this does happen flood waters do not reach the Orange River as the Molopo, south of its confluence with the Kuruman, is completely blocked by huge sand dunes of great age which divert any flood waters into the desert. Below this point, at Zwartmodder, the wide eroded valley of the Molopo is evidence of the volume of water this river once carried.

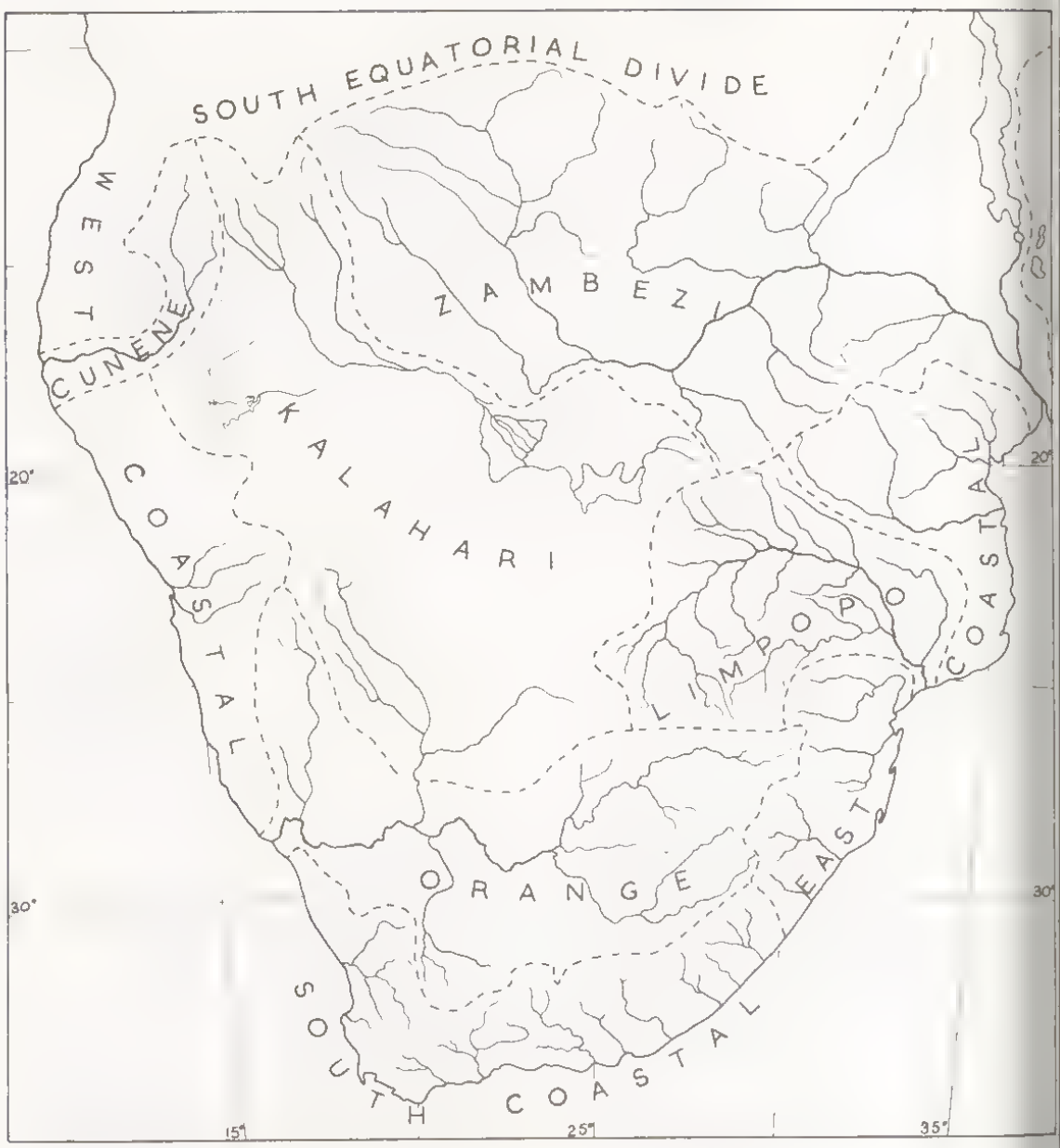

Fig. 1. Drainage basins Southern Africa. (After Wellington).

The Fish River, which rises in the highlands of South West Africa, is subject to periodic flooding. It has been described as a river which can be quite dry one day and a raging siltladen torrent the next. When water is flowing considerable numbers of fish enter this river from the Orange. It is possible that the name "Fish River" may have originated from the numbers of fish that must become stranded in diminishing pools during a dry period.

The lower Orange River can be regarded as starting from the Aughrabies Falls. A short distance above these the Orange River splits into delta-like channels, the main stream passing down the mighty Aughrabies Falls which are undoubtedly a barrier to migrating fish. The secondary streams, which by-pass the main falls on the northern bank and enter the valley some distance below, are no obstacle to the downstream movements of fish, and, under certain circumstances, could be negotiated by Cyprinids and eels trying to get upstream.

The South Coastal drainage basin, the southern tip of the African continent, is occupied by a belt of sub-parallel mountain ranges which divide the basin into the Great Karroo, the Little Karroo, and the Coastal Belt. It is significant that these mountain ranges, which have a profound effect on the rainfall of the interior, have been incised by tributaries of such rivers as the Gouritz, Gamtoos, Sundays and Great Fish (Eastern Cape) whose headwaters thus come into close proximity with those of the southern tributaries of the Orange River. As we find *Labeo umbratus* and *Barbus anoplus* in these systems as well as in the Orange, it is evident that at some stage in their evolution, temporary freshwater links with this latter system must have existed.

Similarly the affinities between the fish faunas of the Orange and the Olifants River, south-western Cape, indicate that at some stage a substantial freshwater link between these two systems must have existed (Jubb 1964). It is of interest to note that a recent map of the hypothetical drainage basins of the inland waters of Africa during the Pliocene (Howell & Bourliere 1964, p. 650) shows a direct link between the highveld Vaal and Orange system, as we know it today, and the Olifants River. This link was broken down subsequently by crustal warping and river capture.

The rivers of the Great Karroo are not permanent, the permanent rivers being associated with the mountains south of this, particularly those rising in the mountains of the Coastal Belt. It is in this latter region that due to climate, and to some extent altitude, suitable conditions are found for exotic trout in many of the mountain streams. Although the water of the larger rivers is alkaline with a pH value of 8·9, and that of rivers rising in Table Mountain Sandstone areas usually neutral, the water of many of the Coastal Belt rivers is distinctly peat-stained and acid with a pH value of 4·5–5·5. This is particularly so between Cape Town and Humansdorp where there is a comparatively short run between the sources and the mouths, and the topography favours the formation of sphagnum bogs at their headwaters with much vegetation cover along their courses. Such rivers are not particularly suitable for trout and are inhabited only by *Sandelia capensis*, endemic small *Barbus* species and eels.

Notes on the Freshwater Fish Fauna of the Cape Province

The most interesting feature of the indigenous fish fauna of the Cape Province is that so many of the species have descended from invaders from northern Africa. The families Cyprinidae, Bagridae, Clariidae and Anabantidae are all considered to have originated and evolved in Asia during the Tertiary (Myers 1938, Menon 1951, Darlington 1957, Liem 1963). In addition to this these families, being strictly intolerant of salt water, all belong to the primary division of freshwater fishes. Their dispersal down Africa must therefore have been subject to the slow process of freshwater links between drainage basins during their evolution when earth movements and other physiographical changes were taking place along the continent. From the existing distribution pattern of the Cyprinidae it has been concluded that a possible invasion route to the south was via the Kalahari basin (Jubb 1964), probably during the Pliocene when, at a stage in the evolution of the Kalahari basin, freshwater links existed (Howell & Bourliere 1964).

The genus *Barbus*, widely distributed over Africa, can be divided into the following main groups:

I. Large species with longitudinally striated scales.

II. Large species with radiately striated scales.
III. Small species with radiately striated scales and an enlarged non-serrated spine in the dorsal fin.
IV. Small species with radiately striated scales and an enlarged serrated spine in the dorsal fin.
V. Small species with radiately striated scales and a slender flexible unbranched dorsal ray.

Endemic forms of all these groups are represented in the fish fauna of the Cape Province. It must be concluded from the above that ancestors representing these five main groups must have reached the southern tip of Africa. In addition to the endemic forms of *Barbus* there are three endemic forms of *Labeo*, family Cyprinidae, two endemic *Gephyroglanis*, family Bagridae, and two endemic *Sandelia*, family Anabantidae. In studying the distribution of *Sandelia* Barnard (1943, p. 253) came to the conclusion that *Sandelia capensis* was already established in certain rivers of the south-western Cape during the Middle Pleistocene period of maximum elevation. Quite apart from this fact the presence of one endemic genus, as well as nineteen endemic species representing four genera, in a fauna comprising thirty species of the primary division of freshwater fishes, and their remarkable distribution considering the topography of the region, indicate that the indigenous fish fauna of the Cape Province is an old one, part of which was already established in the evolving drainages of the region at the start of the Pleistocene.

To the secondary division of freshwater fishes belong those which behave like true freshwater fishes, but which, under certain conditions, can survive in brackish lagoons and even sea water, such as many of the Cichlidae for example. The family Cichlidae, apart from *Tilapia mossambica*, does not occur naturally south of the Orange River. The natural distribution of *T. mossambica*, as distinct from its distribution by man in recent years, is as far south as the Brak River, 33° 44'S. 26° 35'E, just south of the Bushmans River where this species has been found living and breeding in water of the same salinity as that of the sea (see page 54). *Tilapia sparrmanii*, whose southerly limit of distribution in Africa was the Orange River, is now established in such rivers as the Olifants, van Staadens, Kariega and Buffalo where it has been introduced into the river or catchment area as a forage food for the American bass fishes, *Micropterus* species.

The family Cyprinodontidae does not occur naturally within the region. *Fundulus capensis* Garman, 1895, appears in the Catalogue of the Freshwater Fishes of Africa (Boulenger 1915, p. 39) as coming from the Cape of Good Hope, the type locality being False Bay. I wish to record my thanks to Mr. Bruce Turner of New York who has informed me (*in litt.*1963) that Dr. D. E. Rosen, of the Museum of Natural History, New York, a specialist in Poecilidae, has examined the type specimens of *Fundulus capensis* and found them to be mislabelled *Fundulus heteroclitus* an American species. The mosquito fish, *Gambusia affinis affinis* Baird & Girard, 1854, originally imported by aquarists and then used by Jonkershoek Hatchery as a forage food for trout and bass, can tolerate out-of-door conditions and some wild populations now exist in Cape waters.

In the January, 1965, issue of Tropical Fish Hobbyist Dr. George S. Myers, the American authority on freshwater fishes, has drawn attention to the danger of introducing *Gambusia* into waters where it does not occur naturally. It is considered no better a mosquito eater than most indigenous fishes, and it is a destructive creature, not only to fishes of its own small size but also to young of other fishes.

The common carp, *Cyprinus carpio* Linnaeus, 1758, introduced into the Cape in 1896, is now widely distributed. In 1861 Castelnau described a new species from southern Africa, naming it *Cyprinus longicaudis*, a species which has been a mystery for some time. A translation of Castelnau's description of the type locality reads: "I have seen only two specimens of this

species, which came from one of the rivers of the interior of the Colony, I think from the country of the great Namaquas". This mystery was cleared up, however, by Dr. P. H. Greenwood who, in the course of his work on the freshwater fish collection housed in the British Museum, discovered Castelnau's type specimen. He has informed me (*in litt.* 1962) that it is the common goldfish *Carassius auratus*. As the specimen is dated 1857 this is the earliest record of goldfish being introduced into southern Africa.

Field work along the Sundays River system led to the discovery of a population of red-fin *Barbus*, hitherto unrecorded, in the Wit River, a tributary rising in the Zuurberg Mountains. This is the furthest east that these attractive Cape *Barbus* have been found. The distribution of red-fin *Barbus* is of interest in that no other *Barbus* with similar coloration of all the fins were known in southern Africa until Mr. G. Bell-Cross, Department of Game and Fisheries, Zambia, discovered a new species in the headwaters of the Upper Zambezi River. South of this there is *B. gurneyi* with a bright red caudal fin, found in Natal rivers, *B. argenteus* with a bright orange-red caudal fin, found in the Pongolo and Incomati systems, *B. fasciolatus* of the Zambezi system which has an orange-red caudal fin like that of *B. Beirabarbus aurantiacus* and *B. Beirabarbus radiatus*, and *B. rubellus* of the Pongolo and Incomati river systems.

There is no large *Barbus* species with radiately striated scales in the Orange-Vaal system, or any other drainage system south of the Limpopo River until we reach the Olifants, Berg and Breede rivers of the south-western Cape. *Barbus mattozi*, previously known as *B. rapax*, which belongs to this group, is found in the northern and southern tributaries of the Limpopo River, the Gwaai River of the Middle Zambezi system, the Cunene (Bell-Cross *in litt.* 1963) as well as in the western rivers of Angola. Although discontinuous the distribution pattern of the large *Barbus* species with radiately striated scales appears to be linked with the west of Africa rather than with the east (Jubb & Farquharson 1965). Until recently no large *Barbus* species occurred naturally in any of the rivers of the South Coastal Drainage Basin lying between the Breede River and the Umtamvuna River. In 1952 the large yellowfish *Barbus holubi* was introduced from the Orange-Vaal system into the Gouritz River where it is now established. More recent introductions of this same species with fingerlings from the Provincial Fisheries Institute, Lydenburg, include the Kariega River in 1963, and the Tsomo River, a tributary of the Great Kei, in 1964.

Within the region *Gephyroglanis*, a genus found also in the Congo basin, does not occur outside of the Orange and Olifants drainage systems. The specimens of *G. sclateri* reported from the Kafue River by Gilchrist & Thompson (1913, p. 454) are undoubtedly an error in labelling as this species has not been discovered in the Kafue in spite of recent intensive collecting (Jackson 1961 (*a*)). Why there is such a discontinuity in the distribution of this genus is difficult to explain as no adverse ecological conditions are known to exist in the intervening drainage basins. However, like *Barbus serra* and *B. andrewi* of the Olifants and Breede rivers respectively, the presence of *Gephyroglanis gilli* in the Olifants River, and *G. sclateri* in the Orange River, does indicate some affinity with the West African fish fauna.

The most northerly distribution of *Sandelia* is the Langevlei River, just south of the Olifants River drainage system. Not only is this genus absent from the Olifants River system but also from the Sundays, Bushmans, Fish and Keiskama rivers, the Nahoon River being the limit of distribution in the east. Discontinuities in the distribution of some easily recognised species and genera, although difficult to explain ecologically, are not unusual in the fish fauna of southern Africa. Attention has been drawn to the discontinuous distribution of the form of large *Barbus* with radiately striated scales, and the genus *Gephyroglanis*. *Sandelia* has evolved from *Ctenopoma* (Liem 1963), a genus of very hardy fishes found in the Okavango and most of Africa north of this. Other discontinuities in distribution include *Alestes lateralis* which is widely distributed in the Upper Zambezi system, absent from the Middle Zambezi, Sabi, Lundi, Limpopo, Incomati and Pongolo River systems, but is repor-

ted from the Hluhluwe River, Natal (Crass 1960, p. 418). The Angolan species *Barbus argenteus*, which has not been recognised from the Zambezi, Sabi or Limpopo rivers, is found in the Incomati and Pongolo River systems, an identification which has been confirmed by Greenwood (*in litt.* 1962) who compared fresh material from the Transvaal with type material in the British Museum (Natural History). The distribution of *Barbus labialis*, common in the Limpopo and Incomati rivers, extends to the Okavango, Cunene and Kafue River systems, but skips the Zambezi system below the Victoria Falls. *Engraulicypris brevianalis* common in the Limpopo and Pongolo rivers, appears again at two widely separated localities, the Kabompo River, a tributary of the Upper Zambezi, and the Orange River below the Aughrabies Falls, but appears to be entirely absent from the Orange-Vaal system above them. The significance of these discontinuities in distribution, in so far as species are concerned, is that although populations are isolated today by considerable distances, as well as definite watersheds, speciation has been almost static.

The Orange River Scheme

The scheme consists essentially of three primary works, the building of two large dams, the Hendrik Verwoerd and Van der Kloof respectively, and a tunnel under the watershed between the Orange and Fish rivers. The Hendrik Verwoerd Dam will be constructed across the Orange River about three miles upstream of Norvalspont with the Caledon, Orange and Kraai rivers feeding it. To begin with the wall will be some 200 feet above the natural river bed and the capacity about 2,282,000 morgen feet. The inlet to the Orange-Fish tunnel will be about 26 miles above the wall. The tunnel is designed to operate initially under free flow conditions with a water velocity of about 5 miles per hour. The outlet of the tunnel will be into the Thebus River near Steynsburg from where it will flow to the Grassridge Dam, thence into the Fish River.

Breeding migrations up the Caledon and Orange rivers will not be restricted by any high walls, so the Hendrik Verwoerd Dam should remain populated with indigenous species which will include the sporting yellowfishes *Barbus holubi* and *Barbus kimberleyensis*, as well as *Labeo capensis*, *Labeo umbratus*, *Gephyroglanis sclateri*, *Clarias gariepinus* and the common exotic carp *Cyprinus carpio*. To what extent the 51½ mile Orange-Fish tunnel will enable fish to move from the Hendrik Verwoerd Dam into the Fish River system is not known. There is no reason why fish, once having entered the tunnel, should not survive such a journey. Provided they do not eventually end up in an irrigation *cul-de-sac* the Fish River fish fauna will benefit, as at present, contrary to the river's name it comprises but one large indigenous Cyprinid, *Labeo umbratus*, a small minnow, *Barbus anoplus*, two freshwater eels, *Anguilla nebulosa labiata* and *Anguilla mossambica*, and the introduced carp, *Cyprinus carpio*.

Freshwater eels are renowned for their movements along water courses (Jubb, 1963), movements which involve distances of over 1,000 miles from the sea. Once the flow of the upper Fish River has become stabilised no doubt some eels will find their way into Grassridge Dam and eventually reach the Orange River system via the Orange-Fish tunnel. This will be nothing new as the McGregor Memorial Museum, Kimberley, has produced four large female specimens of *A. mossambica* taken from the Vaal River near Kimberley. The South African Museum has a single specimen, also a large female *A. mossambica*, taken from the Caledon River. These eels are entering the Orange River system either at some point where the headwaters of an east coast river are in close proximity with the headwaters of some tributary of the Orange, or via the mouth of the river itself (see page 51). If this latter route is being used then this migration is indeed a remarkable one.

Fish biologists will have to carry out a number of interesting investigations before any final decision can be made regarding the introduction of additional species into the large dams involved in the Orange River Scheme. Of extreme importance will be the temperature regime

of the waters of these dams, and the extent to which water levels will fluctuate. The former factor will have a profound influence on fish life as well as the biological productivity of the water, and the latter a great influence on the shoreline and perimeter waters where most fish feed, and some breed. Affluent rivers and streams will, of course, be of great importance for breeding Cyprinids.

Colloquial Afrikaans Names

I am indebted to Mr. G. F. van Wyk, Senior Fisheries Officer, Division of Inland Fisheries, Stellenbosch, for the following Afrikaans names:

		Page
Galaxias zebratus	Sebra Galaxia	15
Barbus holubi	Kleinbek geelvis	18
B. kimberleyensis	Grootbek geelvis	19
B. capensis	Olifantsrivier geelvis, Clanwilliamse geelvis	19
B. natalensis	Natalse geelvis	20
B. serra	Saagvin	21
B. andrewi	Witvis (van die Berg of en Breërivier (e))	21
B. trimaculatus	Driekol gielieminkie	22
B. paludinosus	Gielieminkie	23
B. hospes	Gielieminkie	24
B. calidus	Rooivlerkie	25
B. trevelyani	Gielieminkie	26
B. pallidus	Gielieminkie	35
B. bergi	Rooivlerkie	27
B. burchelli	Rooivlerkie (Burchell se rooivlerkie)	26
B. afer	Rooivlerkie	29
B. asper	Rooivlerkie	28
B. phlegethon	Rooivlerkie	32
B. tenuis	Rooivlerkie	31
B. anoplus	Gielieminkie	34
B. viviparus	Gielieminkie	33
Labeo seeberi	Sandvis, Clanwilliam Sandvis	37
Labeo umbratus	Moddervis, moggel	37
Labeo capensis	Moddervis, sandvis	38
Engraulicypris brevianalis	Gielieminkie	38
Gephyroglanis sclateri	Klipbarbel	40
G. gilli	Klipbarbel, Olifantsrivier se barbel	41
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Anguilla marmorata	Bontpaling	48
A. nebulosa labiata	Bontpaling	49
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A. bicolor bicolor	Paling	51
Tilapia mossambica	Mossambiekse kurper, blou-kurper, Transvaalse kurper	52
T. sparrmanii	Vleikurper, Sparrman se kurper	55
T. melanopleura	Rooiborskurper	—
Hemihaplochromis philander	Dwergkurper	57
Sandelia capensis	Kaapse kurper	58
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Platygobius aeneofuscus	Klipvissie	61
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Tinca tinca	Seelt	68
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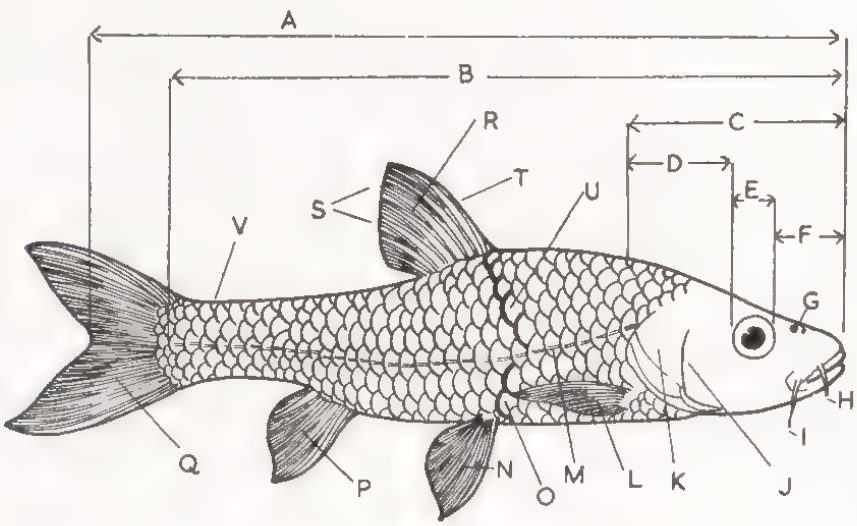


Fig. A. Topography of a *Barbus*.

Anatomical Details and Measurements (fig. A.)

Topography of a *Barbus*

A	Fork length	Vurklengte
B	Standard length	Liggaamslengte
C	Head length	Koplengte
D	Post-orbital distance	Post-okulêre lengte
E	Eye diameter	Oogdeursnit
F	Snout length	Snoetlengte
G	Nostril	Neusopening
H	Anterior maxillary barbel	Voorste voeler
I	Posterior maxillary barbel	Agterste voeler
J	Cheek-groove	Wanggroef
K	Gill cover	Kieudeksel
L	Pectoral fin	Borsvin

M	Lateral line	Sylyn
N	Ventral or pelvic fin	Buikvin
O	Scale count lateral line to origin of ventral fin	Getal skubbe tussen sylyn en buikvin
P	Anal fin	Anaalvin
Q	Caudal fin	Stertvin
R	Dorsal fin	Rugvin
S	Branched rays	Vertakte strale
T	Simple rays	Onvertakte strale
U	Scale count origin of dorsal fin to lateral line.	Getal skubbe tussen rugvin en sylyn
V	Caudal peduncle scales	Stertstam skubbe

Barbels. Sensory organs resembling feelers or tentacles which are situated near the mouth. Those in the region of the nostril are known as nasal barbels, those in the region of the upper jaw maxillary, and those in the region of the lower jaw mandibular or mental barbels.

Eyes. The position of the eye is sometimes described as being lateral or superolateral. In the former case the eyes are visible if viewed from directly above or under the head; in the latter the eyes are visible from directly above the head but not from underneath.

Fins. The ventral or pelvic fins in fig. A are said to be in the abdominal position. In a member of the family Cichlidae, page 52, where the ventral fins are much nearer to the pectoral fins, the ventral fins are said to be in the thoracic position.

There are various forms of dorsal fins:

(i) The dorsal, consisting of all soft rays, can be confluent with the caudal and anal fins as in *Anguilla*, page 45, or separated from the caudal fin as in *Clarias*, page 42.

(ii) The dorsal can consist of simple (unbranched) rays and branched rays as in the Cyprinidae, page 16.

(iii) The dorsal can consist of simple bony rays or spines and soft branched rays as in the Cichlidae, page 52, or the Centrarchidae, page 65.

(iv) There can be two distinct dorsal fins as in the Gobiidae, page 61, and *Perca*, page 69, or the posterior dorsal fin can be an adipose fleshy growth devoid of rays as in *Gephyroglanis*, page 39, or the Salmonidae, page 63.

In the descriptions that follow Roman numerals are used for the spines or simple rays, and Arabic numerals for the soft branched rays.

Gills and gill rakers. Normally there are four cartilaginous gill arches which carry the gill filaments and gill rakers (see fig. 28), page 53. Gill rakers are used by some fishes as a sieving or straining mechanism, being often elaborately developed for this purpose. In many species they are just short cartilaginous projections which, by their number and shape, can be used for identification purposes. The gill raker count is made along the lower portion of the anterior arch.

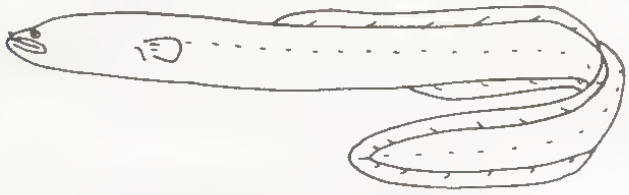
Lateral line. Where scales are present the lateral line scale count is used for identification purposes. If the lateral line is complete this is the total number of pitted scales from the operculum to the end of the caudal peduncle. Where the lateral line is interrupted the count is continued towards the caudal from the last pitted scale. In the case of Cichlidae, Anabantidae and Gobiidae different methods, described later in the text, are used.

Measurements. Unless otherwise stated all measurements are taken in a straight line between verticals, not around the curve or bulge of any part of the body.

Scales. The character, whether longitudinal or radiating, and number of striae on the lunula or exposed portion of a scale is of importance in the determination of a *Barbus* species. To see these striae select a few scales in the vicinity of the lateral line, carefully remove the attached skin containing chromatophores or pigment, and then examine the scales by projection or with a microscope using transmitted light.

KEY TO THE GENERA OF THE FRESHWATER FISHES OF THE CAPE PROVINCE

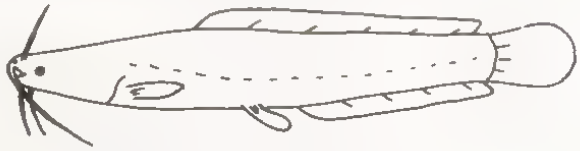
(The key applies to specimens with a total length of 35 mm. and over.)



1. Attenuated in form with dorsal, caudal and anal fins continuous:

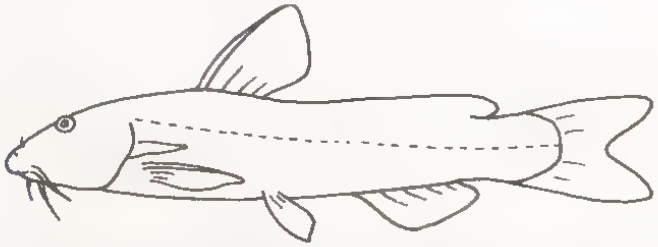
Anguilla page 45

2. The body is covered with large or small scales, see 6; if there are no scales see 3—5.



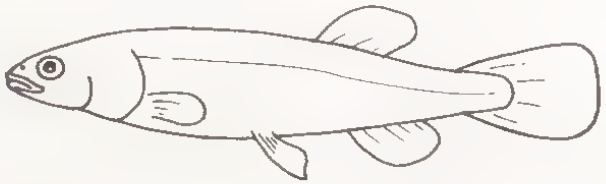
3. The body is moderately attenuated with long spineless dorsal and anal fins; there are four pairs of circum-oral barbels:

Clarias page 42



4. There are two dorsal fins, the anterior short with a pronounced spine, the posterior a well developed adipose fin; there are four pairs of circum-oral barbels, the nasal pair being very short:

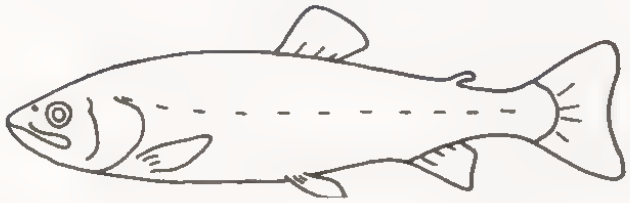
Gephyroglanis page 39



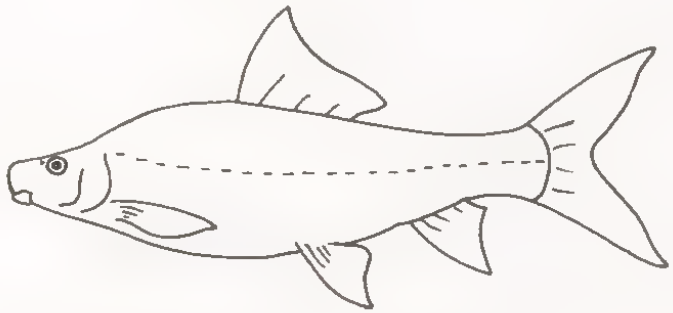
5. There is a single short dorsal fin, the mouth is terminal with no barbels:

Galaxias page 15

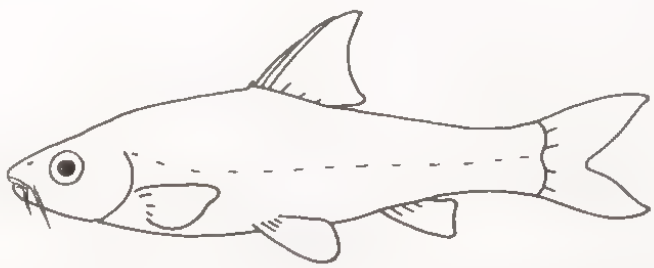
6. The ventral fin is in the thoracic position and has a pronounced spine, see 10—15A; if there is no spine see 15B:
7. The ventral fin is in the abdominal position and has no spine, see 8 and 9:



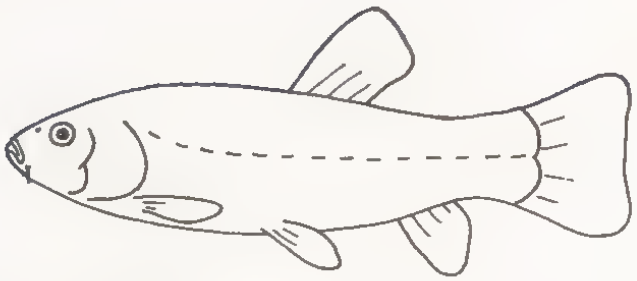
8. There is a small adipose fin present:
   8A. The vomerine teeth are well developed, those on the shaft of the bone numerous:
   Salmo page 63
   8B. The vomerine teeth are confined to the front of the bone:
   Salvelinus page 64



9. There is no small adipose fin present and the jaws are without teeth:
   9A. The mouth is inferior with large well-developed papillose lips; maxillary barbels are present or hidden; the dorsal fin originates well in advance of ventrals; the gill rakers are fine and numerous:
   Labeo page 37

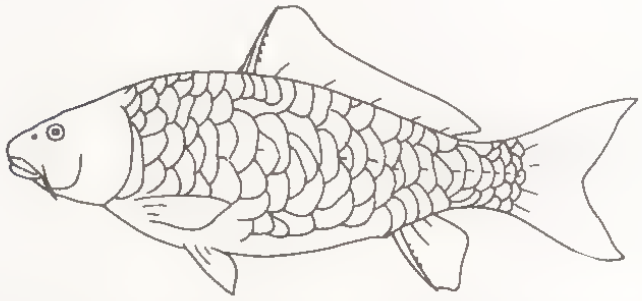


   9B. The mouth is terminal, the lips being thin, moderate or much enlarged; or the mouth is sub-inferior with thin or moderate lips; or the mouth is inferior, the lower jaw without lips but having a sharp horny cutting edge; there are one or two pairs of maxillary barbels; the dorsal fin originates above, slightly in advance or behind the ventrals and the anal fin has no pronounced serrated spine; the lateral line scale count does not exceed 45:
   Barbus page 16



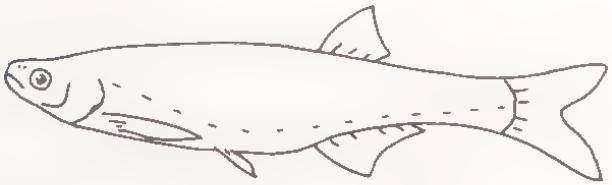
9C. The scales are very small, 95—100 along the lateral line; the mouth is terminal with a single pair of maxillary barbels:

Tinca page 68



9D. The anal fin has a pronounced serrated spine, the dorsal fin is long with 17—22 branched rays; the mouth is terminal with two pairs of maxillary barbels; the scales are moderate and regular, or large and irregular:

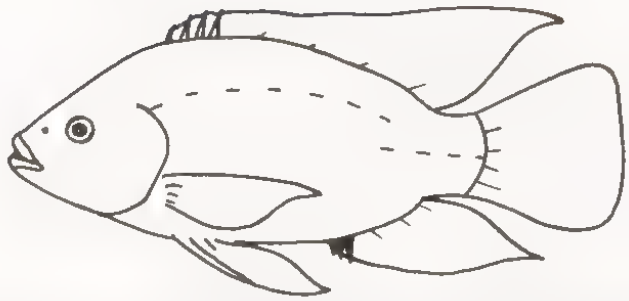
Cyprinus page 67



9E. The dorsal fin originates over the anal fin; the mouth is terminal, oblique and without maxillary barbels:

Engraulicypris page 38

10. Ventral fin in the thoracic position, lateral line not divided, see 13, 14 and 15; lateral line divided, see 11 and 12:

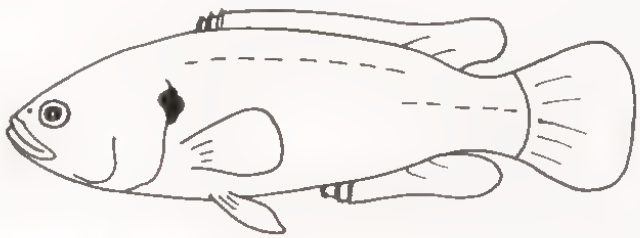


11. The anal fin is short with 3 spines; there is a single nostril on each side of the snout:
    11A. Gill rakers slender, 8—20 on lower portion of anterior arch; pharyngeal teeth fine or moderately fine:

Tilapia page 52

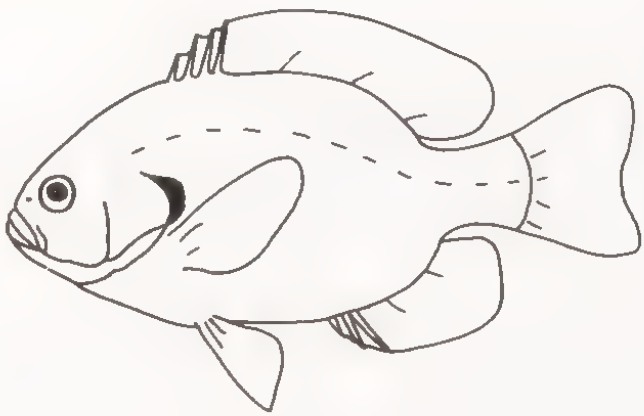
    11B. Gill rakers short and thick, 8—10 on lower portion of anterior arch; pharyngeal teeth coarse:

Hemihaplochromis page 57



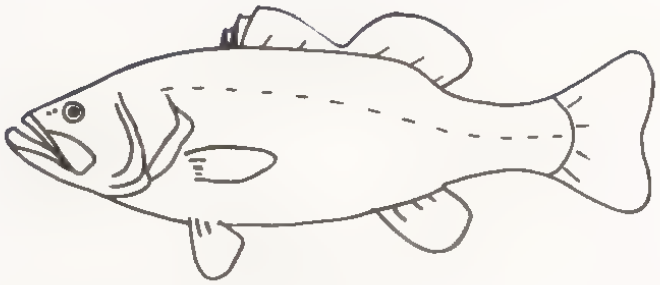
12. The anal fin is long with 6—8 spines.

Sandelia page 58



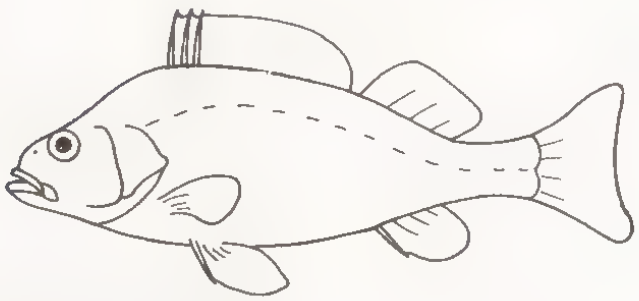
13. The dorsal fin is long and is not divided:

Lepomis page 66



14. The dorsal fin is long, deeply notched or divided, the anterior portion has spines:

Micropterus page 65



15. There are two dorsal fins quite separate:

15A. The anterior dorsal fin has 13 -17 spines:

Perca page 69

15B. The anterior dorsal fin has 6 spines, the ventral fins being joined to form a sucker-like disc;

(i) scales in longitudinal series 30—35:

Glossogobius page 62

(ii) scales in longitudinal series 58—65:

Platygobius page 61

Family GALAXIIDAE

A Southern Hemisphere family of small fishes which belongs to the peripheral division of freshwater fishes. The genus *Galaxias* is shared with Australia, New Zealand and adjacent islands, as well as the southern tip of South America.

Genus ***Galaxias*** Cuvier, 1817.

Fig. 2. Variation in forms of *Galaxias zebratus*. (After Barnard).

Galaxias zebratus Castelnau, 1861. Cape galaxias.

Two species, *G. zebratus* and *G. punctifer* were first recorded and described by Castelnau

from the Cape Flats near Cape Town. The two names, the first "zebra-like" and the second "spotted", both refer to extreme forms of a very variably marked species.

SYNONYMS: *Galaxias punctifer* (Castelnau), 1861.
Galaxias capensis Steindachner, 1894.
Galaxias dubius Gilchrist & Thompson, 1917.

Barnard 1943, pp. 230–244. Harrison 1952 (*a*), pp. 50–54.

DESCRIPTION: A small fusiform fish without scales. Number of vertebrae 40, range 39–41; teeth on jaws and entopterygoid uniserial, a double row, larger and recurved, on the tongue; branchiostegals 7, occasionally 6; gill rakers on anterior arch 2–3 + 9–10; dorsal III–IV 8–9, anal III–IV 8–10.

The above is Barnard's (1943) description as after examining some thousands of specimens he found that body ratios proved most variable and quite inconclusive. Although the extreme forms could be recognised, *zebratus* with zebra markings and rounded caudal, *punctifer* with minute dark speckling and slightly emarginate caudal, the number of intermediate forms made it quite impossible to separate them taxonomically. A collection of fresh specimens from the Malagas River, George, made in 1958, demonstrated this quite clearly. Barnard found that the typically *zebratus* form predominated in mountain streams and the *punctifer* form in lakes or vleis. (See fig. 2.)

In the absence of scales the living fish are often very transparent, the vertebrae, red gills, heart and silvery lining of the body cavity showing through quite clearly. The degree of pigmentation of the skin seems to be largely affected by the general colour of the stream or lake bottom, the handsomest *zebratus* from peat-stained mountain streams being golden brown with dark brown vertical bars or blotches (Harrison 1952 [*a*]).

The largest specimen recorded by the South African Museum was one with a total length of 75 mm.

DISTRIBUTION: *Galaxias zebratus* is confined to the south coastal drainage basin from the Olifants River system eastwards to the Kaaimans River east of George.

REMARKS: Little is known of the breeding habits of the Cape *Galaxias* except that a migration to the sea for breeding purposes is not involved. Barnard (1943) found that *G. zebratus* became mature at about 38–40 mm. and that breeding took place probably throughout the year.

Although *G. zebratus* is not equipped with any form of accessory breathing apparatus, it is an extraordinary hardy species for its size, and can survive a wide range in the condition of the water as well as temperature. Harrison (1952 [*a*]) found that, if placed on slightly damp moss in a bowl, *G. zebratus* could survive for at least ten hours. Kept in water in a small glass tank, away from sunlight and with little attention, he found that this species could survive under conditions far from optimum for at least ten years.

G. zebratus is omnivorous in feeding habits, feeding primarily on small aquatic animals. In confined waters it is known to feed on its own fry and no doubt the fry of other fishes forms part of its diet in natural waters.

TYPE SPECIMEN: Castelnau's type specimens have been lost.

Family CYPRINIDAE

Genus ***Barbus*** Cuvier, 1817.

KEY TO ADULT SPECIMENS OF *BARBUS*

A. Scales longitudinally striated; last dorsal spine not serrated:
  I. Ventral fin originates in advance of dorsal; last dorsal spine thick and bony:
    (*a*) Distance from opercular/preopercular groove to posterior margin of eye shorter than snout length. Scales 36—44, caudal peduncle 16.

B. holubi page 18

(*b*) Distance from opercular/preopercular groove to posterior margin of eye equal to or greater than snout length. Scales 37—45, caudal peduncle 16.
B. kimberleyensis page 19

II. Ventral fin originates below or posterior to the origin of the dorsal; last dorsal spine feebly or moderately bony:
(*a*) Scales 31—38, caudal peduncle 16.
B. natalensis page 20

(*b*) Scales 41—45, caudal peduncle 18.
B. capensis page 19

B. Scales radiately striated:
I. Last dorsal spine enlarged and bony, posterior edge not serrated, two pairs of barbels: Scales 31—35, caudal peduncle 14.
B. trimaculatus page 22

II. Last dorsal spine enlarged, posterior edge serrated, two pairs of barbels:
(*a*) Dorsal branched rays 8, adults greater than 150 mm.
(i) Anal branched rays 5, dorsal strongly serrate: Scales 41—44, caudal peduncle 20.
B. serra page 21

(ii) Anal branched rays 6, dorsal feebly serrate or serrations obsolete in large specimens: Scales 38—41, caudal peduncle 16.
B. andrewi page 21

(*b*) Dorsal branched rays 7, adults smaller than 150 mm.
(i) Anal branched rays 6; fresh specimens with red coloration to fins: Scales 34—38, predorsal 15—17, caudal peduncle 16.
B. calidus page 25

(ii) Anal branched rays 5; no red coloration to fins in fresh specimens:
(*a*) When dorsal fin extended anterior margin at 60°, hind margin approximately 90° to body axis; scales 32—36, caudal peduncle 16, predorsal 13—17.
B. paludinosus page 23

(*b*) When dorsal fin extended anterior and hind margins both at 60° to body axis; scales 37—39, caudal peduncle 16, predorsal 20—22.
B. hospes page 24

III. Last dorsal spine feebly enlarged, posterior edge feebly serrated; usually one pair of maxillary barbels but some adults develop pair of minute anterior barbels: Scales 33—37, caudal peduncle 14, predorsal 12—15.
B. trevelyani page 26

IV. Last dorsal spine not enlarged, slender, flexible and not serrated:
1. Two pairs of maxillary barbels:
(*a*) Radiating striae on scales few, usually less than 10:
(i) Scales 26—30, tubules incomplete, usually confined to first 10, caudal peduncle 12, predorsal 10—12.
B. pallidus page 35

(ii) Scales 26—31, tubules complete, caudal peduncle 12, predorsal 10—11.
B. viviparus page 33

(iii) Scales 29—36, tubules usually complete, caudal peduncle 12, predorsal 13—15; anterior barbels short; males with large conical tubercles on the snout. Fins red.
B. bergi page 27

(iv) Scales 33—36, tubules interrupted, caudal peduncle 14, predorsal 17—18; males with large conical tubercles on the snout. Fins red.
B. burchelli page 26

(*b*) Radiating striae on scales numerous, usually more than 20:
(i) Scales 30—34, tubules usually complete, caudal peduncle 12—14, predorsal 11—12, males with minute tubercles on the snout. Caudal red.
B. gurneyi page 36

2. One pair of maxillary barbels:
(*a*) Radiating striae on scales few, less than 15:
(i) Scales 33—36, tubules usually complete, caudal peduncle 12, predorsal 14—16; no conical warts on head of male. Fins red.
B. phlegethon page 32

(ii) Scales 30—36, tubules interrupted, caudal peduncle 12—14, predorsal 14—18; males with large conical tubercles on the snout. Fins red.
B. afer page 29

(iii) Scales 34—42, tubules interrupted, caudal peduncle 16—18, predorsal 19—25; males with large conical tubercles on the snout. Fins red.
B. asper page 28

(*b*) Radiating striae on scales numerous, more than 15:

(i) Scales 32 36, tubules usually complete, caudal peduncle 12, predorsal 15—20; males without large conical tubercles on the snout. Fins red.
B. tenuis page 31

(ii) Scales 33—37, tubules greatly reduced, interrupted or complete, caudal peduncle 16, predorsal 13—15; in large specimens minute anterior barbels may be present. No red fins.
B. anoplus page 34

Barbus holubi Steindachner, 1894. Smallmouth yellowfish.

Named after the collector Dr. Emil Holub, Austrian explorer and naturalist.

SYNONYMS: *B. gilchristi* Boulenger, 1911; *B. mentalis* G. & T., 1913.

Barnard 1943, p. 153; Groenewald 1958, p. 300.

I follow Groenewald in retaining Steindachner's name for this species. Burchell's (1822) name, *B. aeneus*, cannot be assigned to either of the large *Barbus* species of the Orange River system as his description is inadequate and the figure quite incorrect.

DESCRIPTION: Scales longitudinally striated, 12 47 striae; lateral line 40, range 36—44; predorsal scales 14 15; 6 from dorsal origin to lateral line. 3 5 from lateral line to origin of ventral fin; caudal peduncle 16, range 14 18. Dorsal IV 8, range 7 (occasional) 9, fourth dorsal spine enlarged, stout and not serrated; anal III 5. Ventral fin originates in advance of dorsal fin. Head length 3 (young) 4½ into standard length; mouth sub-inferior, lips thin or sometimes enlarged to form rubber lips, two pairs of barbels present. Small tubercles present on heads of males and females but only males have tubercles on branched rays of anal fin.

B. holubi differs from *B. kimberleyensis* in that the distance from the eye to the opercular preopercular groove is less than the length of the snout. There is also a marked difference in the profile of the heads of these two species, that of the former is convex whereas that of the latter is distinctly flattened.

The general appearance of *B. holubi* is as shown in colour plate I. In clear water the colour is golden with green iridescence along the dorsal surface, some fish being speckled with dark spots. Fish taken from muddy water are pale yellow with olive dorsal surface. Young *B. holubi* are silvery with irregular dark blotches and bars on sides.

DISTRIBUTION: Distributed over the whole of the Orange-Vaal River system, above and below the Aughrabies Falls. Until 1953 *B. holubi* was confined to this drainage basin but, during that year (Harrison 1959), fingerlings from Lydenburg Provincial Fisheries Institute were introduced into the Gouritz River system where this species is now established. In May 1963 the Kariega River, near Grahamstown, was stocked with fingerling *B. holubi* bred at Lydenburg, and in 1964 the Tsomo River, a tributary of the Great Kei, was also stocked.

REMARKS: Breeding migrations take place up rivers usually after the early summer rains Shortt-Smith reports for Basutoland: "When the first rains swell the rivers in spring the annual spawning migration starts, and they (yellowfish) move upstream in impressive numbers. Waterfalls of five feet and more are negotiated with flashing ease, and in the gravel beds they lay their eggs. Later in the middle of summer dark shoals of fry can be seen in the calmer shallows."

After some years of basic research work *B. holubi* has been bred successfully in ponds at the Provincial Fisheries Institute, Lydenburg (Groenewald, 1961). It would appear that *B. holubi* breeds from October to January, well-oxygenated running water and suitable gravel beds being essential for breeding activities.

The record for this popular angling fish is 17 lb. 4 oz.

TYPE SPECIMEN: In the Vienna Museum.

Barbus kimberleyensis Gilchrist & Thompson, 1913. Largemouth yellowfish.

The type locality is Riverton on the Vaal River near Kimberley.

SYNONYM: *B. pienaarii* Fitzsimons, 1949.

Barnard 1943, p. 159; Groenewald 1958, p. 303 (Synonymy).

DESCRIPTION: Longitudinally striated scales, striae 17–50; lateral line 42, range 37–45, predorsal 14–15, origin of dorsal to lateral line 6–7, lateral line to origin of ventral 3–4, caudal peduncle 16. Dorsal fin IV 9, occasional IV 8 or IV 10, fourth spine enlarged, not serrated, bony; anal III 5. Ventral fin originates in advance of origin of dorsal fin. Head length 3½ (young)–4 (adult) into standard length. Mouth large, terminal, with dorsal surface of head strongly depressed and eyes in dorso-lateral position giving this species a characteristic profile. The distance from the eye to the opercular preopercular groove is always equal to or greater than the length of the snout. The lips are thin and never develop into rubber lips. There are two pairs of barbels on each side of the mouth.

The specimen illustrated in colour plate II, was taken from the Vaal River near the type locality north of Kimberley. Specimens taken from muddy water are quite silvery. The smallest specimen examined, standard length 250 mm., had the characteristic profile of this species and was silvery in colour.

DISTRIBUTION: The Vaal River and the main Orange to below the Aughrabies Falls. This species appears to be absent from the Basutoland tributaries.

REMARKS: This predatory *Barbus* is a popular angling fish, the official record being 39 lb. 8 oz. Its typical habitat is rapid water where it preys upon small fishes. There are no records of the breeding habits of *B. kimberleyensis*. Specimens of 100 mm. standard length have been positively identified by Groenewald.

TYPE SPECIMEN: Holotype in South African Museum, S.A.M. No. 9645.

Barbus capensis A. Smith, 1841. Clanwilliam yellowfish.

SYNONYM: *B. seeberi* Gilchrist & Thompson, 1913.

BARNARD 1943, p. 162.

DESCRIPTION: Longitudinally striated scales, striae 10–36, lateral line 42, range 41–45, predorsal 15–17, dorsal to lateral line 7, lateral line to origin of ventral 4–5, caudal peduncle 18, range 16–20. Dorsal fin IV 9, originating above ventral, fourth dorsal simple ray flexible; anal III 5. Length of head 3¼–3¾ into standard length, mouth terminal with a pair of barbels on each side, lips thin or well developed to form rubber lips.

An adult fish illustrated in colour plate III, is a rubber-lipped form taken from the Olifants River near Clanwilliam. Young are silvery with irregular blotches or vertical bars on the sides.

DISTRIBUTION: Endemic to the Olifants River system, south-western Cape.

REMARKS: This is also a popular angling fish, the record weight being 22½ lb. It is reported that mass breeding migrations take place upstream during the months September to December (Piscator No. 14, 1950). Barnard (1943) found that the smallest juveniles were caught in mid-February. *Barbus capensis* is closely related to *B. holubi* of the Orange River drainage basin, differing chiefly in the position of the dorsal fin. As pointed out by Barnard available evidence suggests that *holubi* and *capensis* are derivatives of one ancestral species. We find a similar relationship between *holubi* and *B. polylepis* of the southern tributaries of the Limpopo River system.

TYPE SPECIMEN: In the British Museum, No. 1845. 7.3.99.

Barbus natalensis Castelnau, 1861. Natal yellowfish.

Described from the Tugela River, Natal, by Castelnau in 1861.

SYNONYMS: *B. aureus* (Cope), 1869.
B. bowkeri Boulenger, 1902.
B. lobochilus Boulenger, 1911.
B. m'fongosi G. & T., 1913.
B. robinsoni G. & T., 1913.
B. zuluensis G. & T., 1913.
B. dendrotrachelus Fowler, 1934.
B. grouti Fowler, 1934.
B. marleyi Fowler, 1934.
B. stigmaticus Fowler, 1934.
B. tugelensis Fowler, 1934.

Crass 1960, p. 421, (*B. aureus*), Crass 1964, p. 51, Jubb 1963, p. 16.

DESCRIPTION: Longitudinally striated scales, striae 18–40, lateral line 31–38, predorsal 13–15, dorsal to lateral line 5–6, lateral line to origin of ventral 2–3, caudal peduncle usually 16, range 14–18. Head 3 (young)–5 (large adult) times in standard length, mouth variable, terminal with rubber lips, subinferior with thin or moderate lips (common form), or inferior and wide with horny cutting edge to the lower jaw. There are two well developed barbels on each side of the mouth, both being shorter in the case of those with *Varicorhinus*-like mouths. Dorsal IV 8 or IV 9, fourth simple ray enlarged, moderately bony, not serrated, anal III 5, origin of ventral fin posterior to that of the dorsal.

The specimen illustrated, see colour plate IV, was taken from the Umzimkulwana River north of the Umtamvuna River. Young *B. natalensis* are silvery with irregular dark markings or spots on the sides. Adults preserved in formalin are brown on the dorsal surface with lighter belly.

DISTRIBUTION: The Umtamvuna River and all major rivers south of the Pongolo.

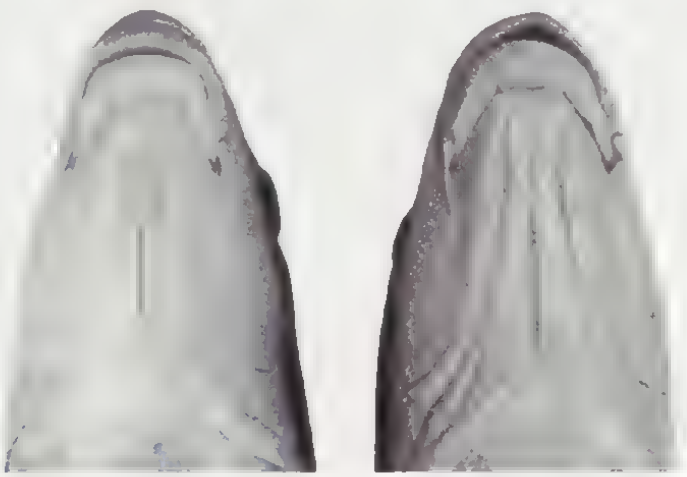


Fig. 3. Ventral view of two specimens of *B. natalensis*. Note variation in lower jaw.

REMARKS: A characteristic of *B. natalensis* (Crass 1964, p. 53) is the adaptation of the mouth, similar to that of *B. marequensis* which has been discussed in such detail by Groenewald (1958, *B. brucii*). This adaptation, which includes a host of intermediate forms of mouth as well, is not evident in young specimens below an average fork length of 75 mm. Although *B. natalensis* and *B. marequensis*, both species of the east coast rivers, develop these wide *Varicorhinus*-like mouths, see fig. 3, it is not a characteristic of any other *Barbus* mentioned in this paper.

B. natalensis is a popular angling fish which attains a weight of about 10 lb.

TYPE SPECIMENS: Castelnau's type specimen has been lost. The type specimen of *B. aureus* is in the Academy of Natural Science, America. The types of *B. bowkeri*, No.1862.8.28, and *B. lobochilus*, No. 1908.12.28., are in the British Museum (Natural History). Fowler's types are in the Museum of the Academy of Philadelphia, America. The type specimens of *B. m'fongosi*, S.A.M. No. 11392, *B. robinsoni*, S.A.M. No. 11371, and *B. zuluensis*, S.A.M. No. 10745, are in the South African Museum.

Barbus serra Peters, 1864. Sawfin.

Originally described from "Cape of Good Hope" the type of this species is in the Krebs Collection, Berlin Museum. The name refers to the strongly serrated dorsal fin. Liversidge (*in litt.* 1963.) has established that Krebs visited the Olifants River, western Cape, in March 1821. As recent collecting has confirmed that this species is endemic to the Olifants River system the type locality of Krebs' specimen is undoubtedly the Olifants River.

Barnard, 1943, p. 170

DESCRIPTION: A large *Barbus* with radiately striated scales, striae 4—17, lateral line 41—44, predorsal 19 20, dorsal to lateral line 7 8, lateral line to origin of ventral 4—5, caudal peduncle 20, range 18 22. Head length 3 3⅓ in standard length, mouth sub-inferior, lips thin, rubber lip varieties being unknown, two well developed barbels on each side of the mouth. Dorsal fin IV 8, the fourth dorsal spine being enlarged, bony and strongly serrated. Anal fin III 5. The ventral fin originates in advance of the dorsal fin.

The live colours of adults are as shown in colour plate V; young fish are silvery with dark blotches or irregular bars on the sides, the fins being tinged with pale orange-salmon.

DISTRIBUTION: Endemic to the Olifants River system, western Cape.

REMARKS: Young *B. serra* can be separated from young *B. capensis* by the radiately striated scales and the presence of a serrated dorsal spine. *B. calidus*, a small species with radiately striated scales and a serrated dorsal spine, has red patches at the base of the dorsal and the anal fins, and in the axils of the pectoral and ventral fins, the anal fin having 6 branched rays.

Breeding migrations are said to occur during the months September to December. Barnard (1943) found that the smallest juveniles were collected during mid-February.

B. serra, which attains a weight of about 3 lb., belongs to a group of large *Barbus* not represented in the Orange River system. The nearest representative of this group is *B. mattozi* Giumaraes, 1884, (= *B. rapax* Steindachner), a species common in the Limpopo system, and present in the Gwaai River, Middle Zambezi system, the Cunene River (Bell-Cross *in litt.*), and northern rivers of Angola.

TYPE SPECIMEN: In the Krebs Collection, Berlin Museum.

Barbus andrewi Barnard, 1937. Witvis.

Andrew Smith, not realising he had two species amongst his material, described *B. capensis* as from the Olifants River as well as the Breede River so a new name had to be created for this second species. It was therefore named *andrewi* by Barnard in honour of the previous author.

Barnard 1943, p. 179; Harrison 1952 (*b*), p. 25.

DESCRIPTION: Radiately striated scales, striae 3–14, lateral line 38–41, dorsal to lateral line 5, lateral line to origin of ventral 4, caudal peduncle 16, predorsal scales 14–15. Head length 3–3⅕ in standard length, mouth terminal, lips thin with two barbels on each side of the mouth. Dorsal IV 8, fourth spine enlarged, bony and usually serrated but in some large specimens the serrations are barely visible. Dorsal fin originates slightly in advance of the origin of the ventral fin. Anal fin III 6, a distinctive feature of this species.

The adult specimen illustrated in colour plate VI, was taken from the Hex River, Breede River system, the water at the time being crystal clear. It will be seen that the colloquial name witvis, or white-fish, is a misnomer and probably refers to the silvery glint caused by fish rolling or turning in the water. Young fish are silvery with irregular dark spots or broken vertical bars on the sides.

The largest fish on record is one of 7 lb. 8½ oz. taken from Brandvlei Lake near Worcester in 1944 (Harrison 1952 (*b*)).

REMARKS: *B. andrewi* breeds in early summer. At that time they can be observed massing in great shoals in suitable spawning places below rapids or low waterfalls. From the location of natural spawning places it is evident that the eggs drop amongst the stones of the river bed where they lodge and hatch within a week in well aerated water, and the fry remain until they are free-swimming. Towards the end of November 1938 ripe specimens of *B. andrewi* were netted and the eggs stripped from one female milted and taken to Jonkershoek Hatchery. They were found hatching in five days, the fry being subsequently successfully reared for scientific purposes (Harrison 1952 (*b*)).

TYPE SPECIMEN: In the South African Museum, Holotype S.A.M. No. 4689 from the Breede River.

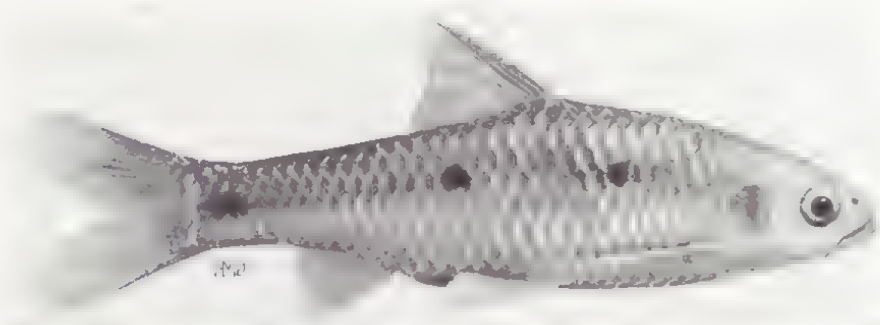


Fig. 4. *Barbus trimaculatus* Peters. Three-spot minnow. ½

Barbus trimaculatus Peters, 1852. Three-spot minnow.

Originally described from the Lower Zambezi River system, the name refers to three lateral spots.

Groenewald 1958, p. 326; Greenwood 1962, p. 185; Crass 1964, p. 58.

DESCRIPTION: Radiately striated scales, striae 3–5, lateral line 33, range 31–35, predorsal 9–13, dorsal to lateral line 5, lateral line to origin of ventral 3, caudal peduncle 14, range 13–16. Length of head 3¾–4¾ times in standard length, mouth sub-inferior, lips thin with two well developed barbels on each side of the mouth. Dorsal III 8, occasional III 7, third dorsal simply ray enlarged, bony and in the form of a stout spine not serrated. This stout spine develops in specimens greater than 30 mm. standard length. Anal fin III 5, origin of ventral fin below that of dorsal.

Live fish taken from clear water are silvery with olive-brown dorsal surface and three dark spots on the sides. These spots are usually about the size of the eye but in some specimens the anterior two may be in the form of an elongated dash. Specimens taken from muddy water are pallid with the anterior two spots often missing but these develop after preservation in formalin solution. Juvenile fish have a dark spot at the base of the anal fin.

DISTRIBUTION: The Vaal River system but has not been found in the Orange River as yet.

REMARKS: Breeding occurs in early summer when shoals of ripe adults move up streams in spate. This species attains a total length of 150 mm.

TYPE SPECIMEN: In the Berlin Museum.

Fig. 5. *Barbus paludinosus* Peters. Minnow. × 1

Barbus paludinosus Peters, 1852. Minnow.

Originally described from the Lower Zambezi River. The name refers to the type locality, a swamp.

Barnard 1943, p. 171; Greenwood 1962, p. 160; Groenewald 1958, p. 309; Crass 1964, p. 59.

DESCRIPTION: Radiately striated scales, striae 3–12, lateral line 32–36, predorsal 13–17, dorsal to lateral line 6–7, lateral line to origin of ventral 3–4, caudal peduncle 16 (range 14–18). Length of head 3–4 times in standard length, mouth terminal, lips thin, two well developed barbels on each side of the mouth. Dorsal III 7, rarely III 8, last branched ray double, third spine enlarged, bony and strongly serrated. The dorsal fin has a characteristic elevated shape, the hind margin being approximately vertical when the fin is extended with the dorsal spine at an angle of about 60° to the axis of the body (Barnard 1943). Anal fin III 5, ventral fin originates distinctly in advance of dorsal fin in most cases. Maximum size in Orange River system about 100 mm.

Live specimens are silvery in colour with olive dorsal surface, fins yellowish or pale olive. In large specimens a faint lateral stripe following the dorsal contour can just be seen. This lateral stripe becomes accentuated in specimens preserved in formalin, and in some specimens the anterior lateral line tubules are bordered with pigment.

DISTRIBUTION: This is a widely distributed species in Africa. It is common in the Vaal River and the main Orange River to below the Aughrabies Falls, but has not been found in the southern tributaries of the Orange River.

TYPE SPECIMENS: In the Berlin Museum together with that of *Barbus gibbosus* (*nec* C. & V.) Peters, 1852, which is a synonym of *B. paludinosus*. In 1905 Boulenger provided a new name *B. longicauda* for *B. gibbosus* but Greenwood (1962) has shown that Boulenger's material should really be referred to *B. amphigramma*, a species not found in the Zambezi River system.

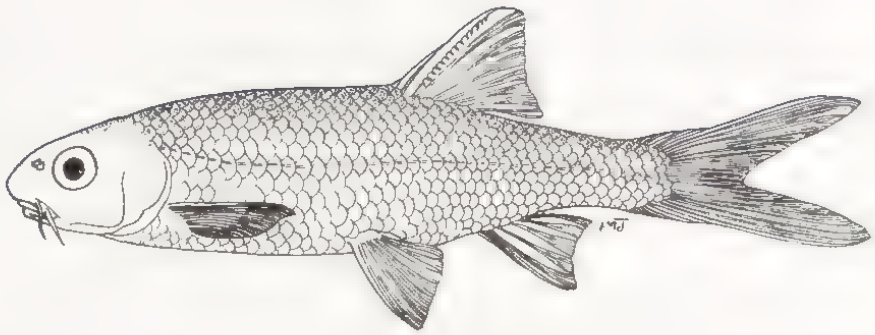


Fig. 6. *Barbus hospes* Barnard. Minnow. × 1 1/3

Barbus hospes Barnard, 1938. Minnow.

The type locality is Goodhouse, below the Aughrabies Falls, Orange River. The name refers to "Goodhouse", the name of a farm on the south bank.

Barnard 1943, p. 174.

DESCRIPTION: Radiately striated scales, striae 3–8, lateral line 37–39, predorsal 20–22, dorsal to lateral line 6–7, lateral line to origin of ventral 4, caudal peduncle 16. Length of head 3–3⅔ times in standard length, mouth sub-inferior, lips thin with two barbels on each side of the mouth. Dorsal III 7, third spine bony and serrated, serrations on basal half directed apically, those on distal half directed towards base of the spine, a characteristic of this species. Anal fin III 5, ventral fin originating in advance of the dorsal. The caudal lobes are elongated, 2¾–3 times in standard length. When the dorsal fin is extended the hind margin forms an angle of approximately 60° with the axis of the body; in the case of *paludinosus* the hind margin of the dorsal fin is approximately vertical.

Preserved specimens are silvery in colour with green-brown dorsal surface, the belly in large specimens being tinged with orange-salmon, fins pale. No fresh material has been examined but it is reported that live specimens do not have red bases to the fins.

DISTRIBUTION: Endemic to the Orange River system below the Aughrabies Falls, where found together with *B. paludinosus*.

TYPE SPECIMEN: Syntypes in the South African Museum, S.A.M. No. 18726.

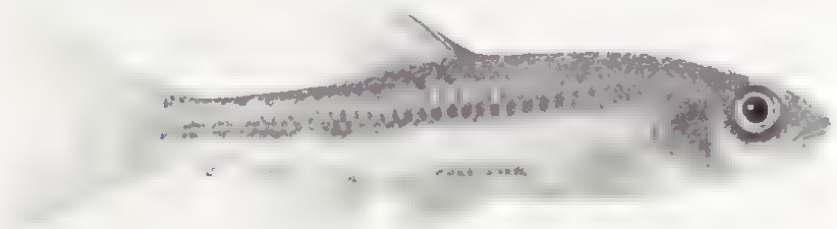


Fig. 7. *Barbus calidus* Barnard. Clanwilliam red-fin minnow. × 1.1

Barbus calidus Barnard, 1938. Clanwilliam red-fin.

The type locality is the Jan Diesel's River, Olifants River system, near Clanwilliam. The name refers to the brightness of the red markings on the fins and the heat of the Olifants River valley.

Barnard 1943, p. 176.

DESCRIPTION: Radiately striated scales, striae 4—14, lateral line 36, range 34—38, predorsal 15—17, dorsal to lateral line 6, lateral line to origin of ventral 3, caudal peduncle 16, 14 in small specimens. Head length 3—3¼ in standard length, mouth sub-inferior, lips thin with two barbels on each side of the mouth. No conical tubercles on head of male. Dorsal fin IV 7, fourth spine enlarged, bony with closely set strong serrations. Anal fin III 6, occasional III 7. This is the only red-fin *Barbus* with a serrated dorsal spine and 6 branched rays in the anal fin. Ventral fin originates slightly in advance of dorsal fin.

Live fish are silvery with a yellowish tinge on the belly and greenish brown speckled dorsal surface. Red at the base of dorsal and anal fins, and axils of ventral and pectoral fins. Caudal fin sometimes with pinkish tinge. For colouring of the fins see colour plates VII and VIII. In preserved specimens a dark lateral stripe develops, occasionally broken into spots posteriorly. Juveniles have spots along the sides and back rather like the young of *B. serra* and *B. capensis* (Barnard 1943). The largest recorded specimen has a total length of 93 mm.

DISTRIBUTION: Endemic to the Olifants River system, south-western Cape.

REMARKS: Breeding appears to occur from early spring to early autumn as Barnard found juveniles from the end of September, and during the months November, February and April. The type locality was visited in November 1958 but in spite of an intensive search along the Jan Diesel's River from its confluence with the Olifants River to its upper reaches in the mountains I failed to find any indigenous fishes, only smallmouth bass, *Micropterus dolomieu*, a species introduced into the system in 1943.

TYPE SPECIMEN: In the South African Museum, Syntypes S.A.M. 18605, 18606, 18756, 22499.

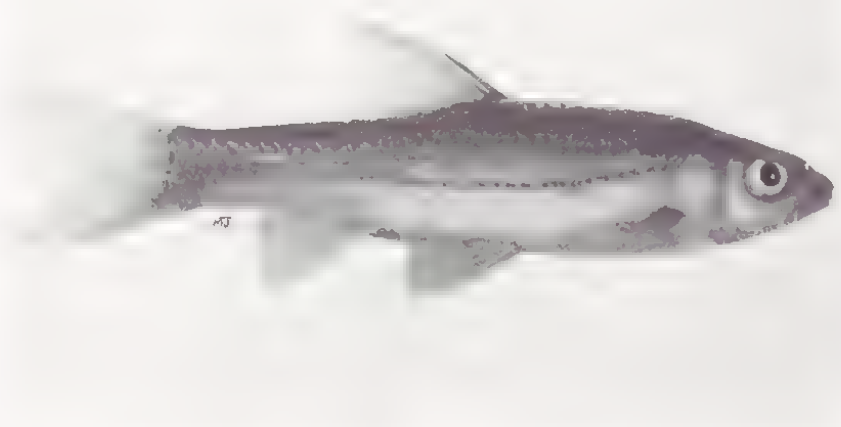


Fig. 8. *Barbus trevelyani* Günther. Minnow. × 1.1

Barbus trevelyani Günther, 1877. Minnow.

Named in honour of the collector, Major H. Trevelyan of King William's Town.

SYNONYM: *B. brookingi* Gilchrist & Thompson, 1913.

Gilchrist & Thompson 1913, pp. 406 & 414.

DESCRIPTION: Radiately striated scales, striae 3—8, lateral line 35, range 33—37, predorsal scales 12—15, dorsal to lateral line 5—6, lateral line to origin of ventral 3, caudal peduncle 14. Head length $3\frac{3}{4}$—$4\frac{1}{4}$ times in standard length, mouth sub-inferior, protractile, lips thin and usually only one barbel on each side of the mouth. Recent collecting has shown that some specimens of over 80 mm. standard length develop one or two minute anterior barbels. Such specimens cannot be separated from *B. brookingi* which is now considered a synonym. Dorsal III 7, occasional III 8, third ray slightly enlarged, spinous with distal extremity feebly serrated in some cases, many without serrations. Anal fin III 5, ventral fin originating slightly in advance of dorsal. Minute tubercles occur on the snout and scales of the male.

Live specimens are silvery white with green-brown dorsal surface, fins practically colourless. In specimens preserved in formalin a thin dark lateral stripe develops following the contour of the dorsal surface, ending in a spot on the caudal peduncle, and the lateral line tubules are outlined with black pigment.

The largest specimen examined had a standard length of 92 mm.

DISTRIBUTION: The Buffalo River and the Nahoon River only.

REMARKS: Great difficulty was experienced in finding specimens of this species in the Buffalo River. Trout have been established in the upper reaches since about 1895, and spotted bass in the lower reaches since about 1946.

The common minnow of the eastern Cape rivers is *B. anoplus*. The isolation of *B. trevelyani*, which appears to be related to *B. puludinosus*, a species which has survived widespread dispersal, in the Buffalo River and the Nahoon River, both of which rise in coastal mountains near the sea, is a zoogeographical puzzle which is not easy to answer.

TYPE SPECIMEN: In the British Museum, No. 1878.1.22.26—32. The type specimen came from the Buffalo River, King William's Town. From the same locality came *B. brookingi* S.A.M. No. 10670.

Barbus burchelli A. Smith, 1841. Red-fin minnow.

Named in honour of John Burchell, a famous English botanist, who travelled in South Africa 1810—1815.

SYNONYMS: *Gnathendalia vulnerata* Castelnau, 1861.

Barbus multimaculatus Steindachner, 1870.

Barnard 1943, p. 188 (*B. vulneratus*); Greenwood 1962 [*in litt.*, discovery of the type specimen of Castelnau's *Gnathendalia vulnerata* in the British Museum (Natural History).]

DESCRIPTION: Radiately striated scales, striae 4—10, lateral line 33—36, sometimes not complete, predorsal 17—18, dorsal to lateral line 5, lateral line to origin of ventral 3—4, caudal peduncle 14, occasional 16. Head $3\frac{1}{4}$—$3\frac{3}{4}$ times in standard length, mouth sub-inferior, lips thin with two well developed barbels on each side of the mouth. Males have conical tubercles on the head. Dorsal IV 7, fourth simple ray flexible, not enlarged. Anal fin III 5, ventral fin originating slightly in advance of dorsal.

A male from the Witte River, Breede River system, is illustrated in colour plate VII. In material preserved in formalin the lateral stripe and spots become accentuated.

DISTRIBUTION: The Breede River system, also the Nieuwejaar, Grashoek and Kars Rivers lying to the west of the Breede, and the Duivenhoks and Kaffirkuils Rivers lying to the east.

REMARKS: *B. burchelli* reaches maturity at a fork length of 50—55 mm. in the case of males, and 55—60 mm. in the case of females; the largest specimen on record is one of 90 mm. fork length.

Andrew Smith, beyond the broad statement "various rivers of the Cape Colony" did not record a type locality for his *B. burchelli*. The type being lost, Barnard experienced some difficulty in accepting Andrew Smith's description but eventually concluded that it referred to the small red-fin *Barbus* of the Berg River system. During recent investigations Greenwood discovered some of Castelnau's types in the British Museum, amongst these being the skin of *Gnathendalia vulnerata*. Examination of this, in conjunction with Andrew Smith's description and figure of *burchelli*, has led him to the conclusion that Castlenau's *vulnerata* is a synonym of *burchelli*. The type locality of *vulnerata* is Genadendal on the Zonder Eind River, a large tributary of the Breede River.

TYPE SPECIMEN: The type has been lost.

Fig. 9. *Barbus bergi* Boulenger. Red-fin minnow. × 1.1 (After Boulenger).

Barbus bergi Boulenger, 1911. Red-fin minnow.

Described from the Berg River to which the name, incorrectly printed *burgi* in the original description, refers.

Barnard 1943, p. 185 (*B. burchelli*).

DESCRIPTION: Radiately striated scales, striae 4–16, lateral line 29–36, tubules usually complete, predorsal 13–15, dorsal to lateral line 4, lateral line to origin of ventral 3, caudal peduncle 12. Head 3½—3¾ times in standard length, mouth sub-inferior, lips thin with one pair of barbels on each side of the mouth in adults, the anterior pair being short or absent in specimens smaller than 50 mm. fork length. Males develop conical tubercles on the snout and forehead. Dorsal IV 7, fourth simple ray flexible. Anal fin III 5, ventral fin originating below origin of dorsal.

Live specimens resemble *B. burchelli* in colour, see colour plate No. VII. The red colouring of the fins is a distinctive feature of this group of Cape fishes, but the colours fade quickly when preserved in formalin. In preserved material the general dark coloration is retained and a dark lateral stripe develops.

DISTRIBUTION: Endemic to the Berg River system and the Eerste River, south-west Cape.

REMARKS: *B. bergi* and *B. burchelli* are closely related, the chief difference being the delayed appearance of anterior barbels in the former. For discussion on nomenclature see *B. burchelli*. The largest specimen recorded is one with a fork length of 117 mm. This species reaches maturity at a fork length of about 60 mm.

TYPE SPECIMEN: In the British Museum (Natural History), registered No. 1901.2.11. 14–16.

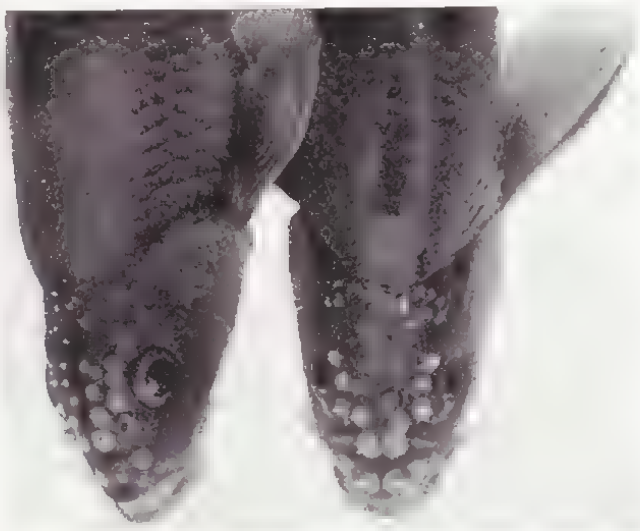


Fig. 10. Nuptial tubercles on head and snout of male *Barbus asper*.

Barbus asper Boulenger, 1911. Plump red-fin minnow.

Originally described from two river systems, the Groot River (Gamtoos R. system) and the Le Roux River (Gouritz R. system). The name refers to the spine-like tubercles on the snout of the male.

Barnard 1943, p. 196; Jubb 1959, p. 34.

DESCRIPTION: Scales radiately striated, striae 6–12, lateral line 34–42, predorsal 19–25, dorsal to lateral line 6–8, lateral line to origin of ventral 5–6, caudal peduncle 18, range of typical form 16–20, but amongst a large number of specimens from the Homtini River near Knysna two specimens were found with caudal peduncle scale counts of as low as 12. Head $3\frac{1}{2}$–4 times in standard length, mouth sub-inferior, lips moderate with a single well developed barbel on each side of the mouth. Adult males with large conical tubercles on the snout and sometimes minute spinose nuptial tubercles on the scales (see fig. 10). Dorsal III 7, last simple ray flexible, not enlarged, anal fin III 5, origin of ventral below that of the dorsal.

A female from the Homtini River is illustrated in colour plate VIII. Boulenger's figure (1911, fig. 154, also reproduced in Gilchrist & Thompson, 1913, fig. 86) is typical of the male. Specimens from Meirings Poort (Gouritz River system) were similar in colour to the Homtini River specimens but those from the Doring River (Gouritz River system) were more silvery grey than dark brown. In material preserved in formalin the red coloration of the fins quickly fades, the dorsal surface remains dark and a dark lateral stripe develops.

The largest specimen examined had a fork length of 115 mm.

DISTRIBUTION: From the Gouritz River system eastwards to the Kouga, Baviaans, Groot and Kariega rivers (Gamtoos River system) but excluding the Kromme, Zeekoe and Kabeljouws rivers, as well as coastal tributaries of the Gamtoos River.

REMARKS: Ripe males and females were collected in the Homtini River and Meirings Poort River during the month of October. In both cases shoals were found below waterfalls in rocky runs where, it is assumed, they had collected for spawning purposes.

From the scale counts given for typical *B. asper* it will be seen that, like the closely related *B. afer* which follows, this is a polymorphic species. Some populations contain odd specimens which differ even more widely from typical *B. asper* but the small crowded scales remain a distinctive feature. In the Moordenaars River, a mountain tributary of the Kouga River (Gamtoos River system), a population of red-fin minnows was found with characteristics closer to *B. afer*. Material from the Kabeljouw River and lower tributaries of the Gamtoos River is also nearer to *B. afer*. Thus, regarding *B. asper* and *B. afer* as polymorphic species, their distribution, though still puzzling, becomes more logical.

TYPE SPECIMEN: Boulenger's types are in the British Museum, registered number 1909.12.8. 6–10. There is a paratype in the South African Museum, No. S.A.M. 10664.

Fig. 11. *Barbus afer* Peters. Red-fin minnow. Female. × 1

Barbus afer Peters, 1854. Red-fin minnow.

Described from three specimens, registered No. 5413, in the Krebs collection, Berlin Museum. The name refers to Africa.

SYNONYM: *B. senticeps* J. L. B. Smith, 1936.

Barnard 1943, p. 200 (*B. senticeps*) and p. 217 (*B. afer*.)

DESCRIPTION: Radiately striated scales, striae 8–12, lateral line 30–36, predorsal 14–18, dorsal to lateral line 5–6, lateral line to origin of ventral 3–4, caudal peduncle range 12–16, in some populations mean figure is 12, whereas in others it is 14. Although variable in scale counts the larger body scales of *B. afer* are quite characteristic when compared with those of *B. asper*. Head $3\frac{1}{4}$–4 times in standard length, mouth sub-inferior, lips moderate with a single well developed barbel on each side of the mouth. Dorsal III 7, third simple ray flexible, not

enlarged, anal III 5, ventral fin originating slightly in advance of the origin of the dorsal. Males have large conical tubercles on the snout (see fig. 10).

B. afer resembles *B. asper* in colour, see colour plate VIII. Specimens preserved in formalin are dark on the dorsal surface, the scales being heavily pigmented, the belly is much lighter and there is a dark lateral stripe.

The largest specimen examined had a fork length of 100 mm.

DISTRIBUTION: Typical *B. afer* occur in the Kromme and Zwartkops rivers. The more variable form is found in the coastal rivers from the Zeekoe River eastwards to the Sundays River but excluding the van Staadens River.

REMARKS: Its discovery having eluded widespread collecting the identification of *B. afer* has been a mystery for some time. In September 1962 Dr. Deckert of the Berlin Museum very kindly loaned the Albany Museum Peters' three type specimens of *B. afer*, registered under Berlin Museum No. 5413. Two of these, 85 mm. and 78 mm. standard length, were marked type specimens, and the third, also 85 mm. standard length, was marked cotype. Considering their age the two type specimens were in fair condition as compared with the cotype which was in very poor condition indeed. Undoubtedly the cotype was the specimen examined and described by Barnard (1943 p. 217) who has recorded the fork length of the specimen. If Barnard had had the two type specimens available when he was carrying out his revision he would have recognised them as being females of what was described as *B. senticeps* by J. L. B. Smith in 1936. Their squamation is typical of the type specimen of *B. senticeps*, there being 30–31 scales along the lateral line, which is interrupted, 14–15 predorsal scales, 5 from the dorsal to the lateral line, 3 from the lateral line to the origin of the ventral, and 12 around the caudal peduncle.

From Barnard's published data the characters of *B. afer* from the Kromme and Zwartkops Rivers are fairly uniform. In April 1959 a population of red-fin minnows was found in the upper reaches of the Wit River (Sundays River system) just below the Zuurberg Mountains and a representative collection was made. A detailed study of these specimens, most of which bore a great superficial resemblance to *B. afer*, showed that the lateral line scale count had a range of 31–36, with a predorsal count of 16–18, 5–6 from the dorsal to the lateral line, 3–4 from the lateral line to the origin of the ventral fin, and 12–16 scales around the caudal peduncle, the mean value being 14. The greatest variation from typical *B. afer* is the increased number of scales around the caudal peduncle. However, as the above characteristics agree with material from the Baakens River, as well as the Kabeljouw and Gamtoos Rivers, and influenced by the number of intermediate forms as well as their logical distribution, it was decided that these populations are a form of *B. afer* rather than that they represent a new species.

Boulenger (1911, fig. 155) has illustrated *B. anoplus* from Port Elizabeth but, apart from the slightly high number of scales in the lateral line, this is considered to be an illustration of the variable form of *B. afer* from the Baakens River. Boulenger also illustrated what he considered to be *B. afer* (1911, fig. 156). As pointed out by Barnard this is, in fact, an illustration of *B. bergi* without anterior barbels. Having seen the two type specimens of *B. afer* it is not at all clear how Peters determined the lateral line scale count to be 26, the figure he published. No doubt this error, as well as the lack of a recorded type locality, led to the confusion that has resulted. As regards the characteristics of the cotype, published by Barnard, the specimen is in too poor a condition to determine whether damage during its life-history could account for the extraordinarily low predorsal and lateral line scale counts. In other respects the cotype resembles the types.

TYPE SPECIMENS: Two type specimens, Registered No. 5413, in the Berlin Museum. The type of *B. senticeps* is housed in the Department of Ichthyology, Rhodes University, Grahamstown.

Fig. 12. *Barbus tenuis* Barnard. Slender red-fin minnow. × 1.2

Barbus tenuis Barnard, 1938. Slender Red-fin minnow.

Described from the Gouritz River system, the name refers to the slender shape of this species.

Barnard 1943, p. 202.

DESCRIPTION: Radiately striated scales, striae 14–24, lateral line 32–36, tubules sometimes interrupted, predorsal 15–20, dorsal to lateral line 5, lateral line to origin of ventral 3, caudal peduncle 12–14. Head length, which is greater than depth of body in this case, $3\frac{1}{3}$—4 times in standard length, mouth inferior, lips thin with a single posterior barbel on each side of the mouth. Males do not develop conical tubercles on the head. Dorsal IV 7, first simple ray obscured in adults, fourth simple ray flexible, not enlarged, anal III 5, origin of ventral fin in advance of that of dorsal.

Live specimens were collected together with *B. asper* in Meirings Poort, a mountain tributary of the Gouritz River system. Although their general coloration was similar to that of *B. asper* specimens of *B. tenuis* could be detected by their shape and squamation. Material preserved in formalin is dark on the dorsal surface, the belly scales lighter but quite heavily pigmented, and there is a dark lateral stripe.

DISTRIBUTION: The mountain tributaries of the Gouritz River system.

REMARKS: In addition to squamation and its slender shape *B. tenuis* differs from *B. asper*, with which it is associated in the mountain tributaries of the Gouritz River, by the fact that males do not develop conical tubercles on the head. This same characteristic separates it from *B. burchelli* in the west, and *B. afer* in the east. It differs from *B. phlegethon* in its larger size, attaining a fork length of 85 mm., and the much greater number of striae on the scales.

TYPE SPECIMEN: The type has been lost. The specimen illustrated in fig. 12 came from the type locality.

Fig. 13. *Barbus phlegethon* Barnard. Red-fin minnow. × 1.3

Barbus phlegethon Barnard, 1938. Red-fin minnow.

Described from the Boontjes River, Citrusdal, a tributary of the Olifants River, and the main Olifants River south of Citrusdal. The name, a fiery river of the underworld, refers to the summer climate of the Olifants River valley.

Barnard 1943, p. 204.

DESCRIPTION: Radiately striated scales, striae 4—8, lateral line 33—36, tubules usually complete, predorsal 14—16, dorsal to lateral line 4—5, lateral line to origin of ventral 3, caudal peduncle 12. Head $3\frac{1}{2}$—4 times in standard length, mouth sub-inferior, lips thin with a single posterior barbel on each side of the mouth. No conical tubercles on the head of the male. Dorsal III 7, third simple ray flexible, not enlarged, anal III 5, ventral fin originating below the origin of the dorsal.

Live fish are silvery in colour, the dorsal surface being heavily speckled with brown. Base of the dorsal, ventral, most of the caudal and anal, axil and base of pectoral are a brilliant red. On preservation a dark lateral stripe which ends in a large spot on the caudal peduncle develops.

DISTRIBUTION: Endemic to the Olifants River system in the south-western Cape.

REMARKS: This appears to be a small species, the largest specimen on record being one with a fork length of 68 mm. It is distinguished from *calidus*, also endemic to the Olifants River, by the non-serrate dorsal simple ray and the presence of only a single pair of barbels.

The type locality was visited in November 1959 but no specimens of *B. phlegethon* could be found at Citrusdal or at Clanwilliam. In January 1964 Mr. K. J. van Rensburg of the Department of Nature Conservation collected specimens in a tributary of the Olifants near Keerom, about 20 miles upstream from Citrusdal. This collection was presented to the Albany Museum.

TYPE SPECIMEN: There are syntypes in the South African Museum, No. S.A.M. 22484.

Fig. 14. *Barbus viviparus* M. Weber. Minnow. · 1 3

Barbus viviparus M. Weber, 1897. Minnow.

Described from the Umhloti River, Verulam, Natal and the Umlaas River, Isipingo. Barnard (1943) has shown that the name originated from faulty observations regarding alleged viviparity of this species.

Barnard 1943, p. 218, 1948, p. 426; Crass 1960, p. 433, 1964, p. 62.

DESCRIPTION: Radiately striated scales, striae 5–9, lateral line 26–31, predorsal 10–11, dorsal to lateral line 4, lateral line to origin of ventral 3, caudal peduncle 12. Head 3½–4½ times in standard length, mouth terminal, lips moderate with two barbels on each side of the mouth, the posterior pair being well developed. Dorsal III 8 with occasional III 7, the third simple ray flexible, not enlarged, anal III 5, origin of ventral fin below that of dorsal.

Live specimens are silvery in colour with olive dorsal surface, fins very pale olive. On preservation in formalin pigmentation on each side of the lateral line tubules becomes accentuated, and a dark lateral line following the dorsal profile develops, as well as a dark spot on each side of the base of the anal fin. The lateral stripe meets the lateral line at a point posterior to the last anal ray.

DISTRIBUTION: From the Umtamvuna River northwards through Natal to the Zambezi River system.

REMARKS: In view of its relationship to *B. lineomaculatus* and *B. unitaeniatus* the taxonomy of *B. viviparus* has been investigated in some detail by Barnard (1943, 1948) and Greenwood (1962, *in litt.*), both of whom have examined the type specimens. These workers accept the validity of this widespread species.

The squamation characteristics of *B. viviparus* overlap those of *B. pallidus* but the complete lateral line of the former contrasts greatly with the low number of lateral line tubules found in specimens of the latter. In live fishes the golden colour of breeding males of *B. pallidus* has not been observed in *B. viviparus*, nor the small lateral dots (*B. hemipleurogramma*) associated with females of *B. pallidus*. In addition to this the pigmentation of specimens of *B. viviparus* preserved in formalin, described above, differs quite markedly from that of preserved *B. pallidus*.

The largest specimen *B. viviparus* examined had a fork length of 60 mm.

TYPE SPECIMENS: Type specimens are housed in the Amsterdam University Museum. Four paratypes are in the South African Museum, S.A.M. 22083.

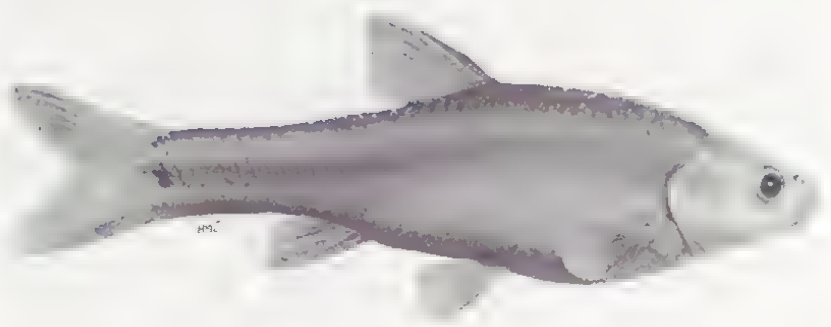


Fig. 15. *Barbus anoplus* M. Weber. Chubby-head minnow. · 1 2
Eastern Cape form with complete lateral line.

Barbus anoplus M. Weber, 1897. Chubby-head minnow.

Originally described from the Buffels River, Gouritz river system. The name, meaning "unarmed", probably refers to the lack of a dorsal spine.

SYNONYM: *B. karkensis* Gilchrist & Thompson, 1913.

Barnard 1943, pp. 206—217; Crass 1960, p. 439, 1964, p. 67.

DESCRIPTION: Radiately striated scales, striae 20 38, lateral line 33 37, lateral line tubules complete, interrupted or incomplete, predorsal 13 15, dorsal to lateral line 5 6, lateral line to origin of ventral 3 4, caudal peduncle 16, 12 14 in small specimens. Head $3\frac{1}{4}$ 4 times in standard length, mouth terminal, lips medium with lower labial grooves interrupted medianly, a single posterior barbel, $\frac{1}{2}$ $\frac{3}{4}$ eye diameter, on each side of the mouth. In specimens from the Olifants River, south-western Cape, small anterior barbels may be present in large fish. Dorsal IV 7, first simple ray obscured in adults, fourth simple ray flexible, not enlarged, anal III 5, ventral fin originating slightly in advance of dorsal.

Living fish are mainly silvery in colour with olive dorsal surface, there are no red fins. During the early summer months males become quite golden on the sides and belly. When preserved in formalin a dark lateral stripe, which ends in a dot on the caudal peduncle, develops.

DISTRIBUTION: With the inclusion of *B. karkensis* (Crass, 1960) the distribution of this species is quite remarkable in that it has managed to disperse over practically the whole of the Cape Province region. It is absent from the Berg and Breede Rivers as well as the coastal rivers of the south-west and south Cape. It has not been recorded from the Gamtoos River system but this requires confirmation. In the Orange River it has not been found below the Aughrabies Falls but, its penetration into the headwaters of the Orange in the Basutoland highlands has been halted only by high waterfalls. Crass (1960) reports that this is the common minnow of streams in the upper midlands and Drakensberg foothills 4,000—5,000 feet altitude. In the headwaters of the Caledon River it has been found at 6,500 feet.

REMARKS: Barnard has discussed in detail the characters of three forms of *B. anoplus*. To these characters we can add those of *B. karkensis*, a form found in the Great Fish River, eastern Cape, and those rivers north-east of this to Natal. In the *karkensis* form the range in scale counts remains the same but the lateral line tubules are usually complete. Many individuals in these latter populations also lack the distinctive "chubby-head" profile.

Breeding migrations have been intercepted in the Buffalo River, near King William's Town, during the month of October. The largest specimen examined had a fork length of 85 mm.

It should be noted that Boulenger's (1911) illustration of *B. anoplus*, fig. 155, reproduced by Gilchrist & Thompson (1913), fig. 87, is not of a specimen of *B. anoplus* but of a form of *B. afer* from the Baakens River, Port Elizabeth. On page 428 these latter authors also record spine-like tubercles on the snout for *B. anoplus* but their material from Modderfontein and Wonderfontein should be referred to *Barbus motebensis* from the Limpopo River system.

TYPE SPECIMENS: Barnard has examined type specimens of *B. anoplus* housed in the Amsterdam University Museum.

Barbus pallidus A. Smith, 1841. Goldie.

Andrew Smith's name refers to one of the colour phases of this species whereas the colloquial name refers to the bright golden colour of breeding males.

Barnard 1943, p. 192, Groenewald 1958, p. 314. (*B. hemipleurogramma.*); Crass 1964, p. 62.

SYNONYM: *B. hemipleurogramma* Boulenger, 1911.

DESCRIPTION: Radiately striated scales, striae 4–8, lateral line 26–30, usually incomplete, the tubules ending before or about the middle of the body, predorsal 10–12, dorsal to lateral line 4, lateral line to origin of ventral 3, caudal peduncle 12. Head $3\frac{1}{2}$–$4\frac{1}{3}$ times in standard length, mouth sub-inferior, lips thin with two well developed barbels on each side of the mouth. Dorsal III 7 or III 8, in Cape populations III 7 predominates, third spine flexible and not enlarged, last branched ray double. Anal fin III 5, ventral originates below dorsal.

During the summer months adult males are a bright golden colour, females being mostly silvery grey with a series of faint lateral spots, see colour plates IX A and IX B. In preserved material the lateral spots of the female become more accentuated (see Boulenger's illustration of *B. hemipleurogramma*), and the spot at the base of the anal fin becomes apparent in both sexes.

DISTRIBUTION: From the Gamtoos River system eastwards to the Kariega River system near Grahamstown. Also found in the Transvaal tributaries of the Vaal River and some rivers of Natal.

REMARKS: Material from the Provincial Fisheries Institute, Lydenburg, collected in the Mooi River, Vaal River system, and assigned to *B. hemipleurogramma*, has been examined and cannot be separated from *B. pallidus*. Specimens from the Buffalo River, Natal, forwarded by Mr. Crass, proved to be the same species.

Andrew Smith gave the type locality of *pallidus* as the "clear streams in various parts of the Cape Colony". As Barnard (1943) remarks, Andrew Smith not only travelled widely in the Cape but set out on one of his most important expeditions from Port Elizabeth. It is reasonable, therefore, to assume that *pallidus* came from some river in the neighbourhood.

B. pallidus is a small species, attaining maturity at about 40 mm. and seldom exceeding a total length of 70 mm.

TYPE SPECIMEN: The type specimen appears to have been lost.

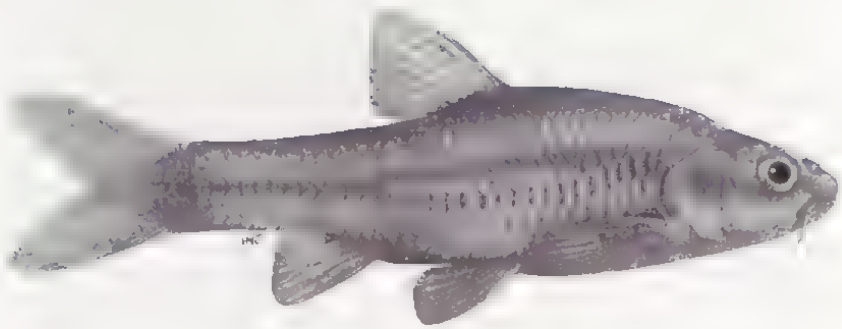


Fig. 16. *Barbus gurneyi* Günther. Red-tail minnow. × 1.3. Male with numerous small tubercles on the snout.

Barbus gurneyi Günther, 1868. Red-tail minnow.

Described from Natal and named in honour of the collector Mr. J. H. Gurney of Port Natal (Durban).

Crass 1960, p. 430; Crass 1964, p. 65.

DESCRIPTION: Radiately striated scales, striae 15–30, lateral line 30–34, predorsal 11–12, dorsal to lateral line 5, lateral line to ventral 2, with occasional 1, caudal peduncle usually 12, range 12–14. Head 3–3½ times in standard length, mouth terminal, lips moderate with two barbels on each side of the mouth, the posterior pair well developed. Adults have numerous small tubercles on the snout, especially breeding males. Dorsal III 7, third simple ray flexible, anal III 5, the ventral fin originates very slightly ahead of the origin of the dorsal.

From a description by Crass (1964) the breeding coloration of this species is quite distinctive. The whitish tubercles on the head stand out against the brownish olive dorsal surface. The iris is pale golden, gill covers bright golden, the flanks bronze with dark markings along the lateral line posteriorly. The belly is dull pinkish white. The caudal fin is bright red with a narrow white border, the other fins being pale rust colour except the distal portion of each which is a dull white.

The largest specimen examined had a fork length of 75 mm. but it is reported to attain a length of a little over 100 mm.

DISTRIBUTION: From the Umtamvuna northwards to the Tugela River.

REMARKS: Characteristics of this species are the rapidly rising nape, the small conical tubercles on the snout and forehead of breeding adults, the well developed posterior barbels, and the very low number of scales between the lateral line and the origin of the ventral fin. Specimens preserved in formalin have a thin dark lateral stripe which joins the lateral line posterior to the hind edge of the anal fin and ends with a dot on the caudal peduncle.

TYPE SPECIMENS: In the British Museum (Natural History), registered No. 1862.8.28. 14–21.

Genus *Labeo* Cuvier, 1817.

KEY TO *LABEO*

I. No visible barbels; scales very small and numerous, being greater than 80 along the lateral line:
L. seeberi page 37

II. Two barbels on each side of the mouth:
(i) Numerous small papillae on upper lip; scales moderate, 53—68 along the lateral line, 26—34 around the caudal peduncle:
L. umbratus page 37

(ii) Very small papillae on inside of the upper lip in transverse rows or plicae; scales moderate, 42—50 along lateral line:
L. capensis page 38

Labeo seeberi Gilchrist & Thompson, 1911. Clanwilliam sandfish.

Described from the Olifants River, Clanwilliam, and named in honour of the collector Mr. C. R. Seeber.

Barnard 1943, p. 138.

DESCRIPTION: Scales small, 82–90 along the lateral line with about 36 (young) to 50 (adult) scales around the caudal peduncle. Length of head 4 (young) to $5\frac{1}{4}$ (adult) times in standard length. Mouth inferior, lips well developed, inner surface of both lips with very small papillae forming transverse rows or plicae, and there is a single hidden small barbel on each side of the mouth. Dorsal fin IV 9, occasional IV 10, anal III 5, caudal deeply forked.

A specimen taken below the Clanwilliam Dam is illustrated in colour plate X. Specimens preserved in formalin are dark grey in colour with pale underparts.

The largest specimen on record is one with a total length of 380 mm. in the South African Museum.

DISTRIBUTION: This is a unique species endemic to the Olifants River system.

REMARKS: The intestine is very long and intestinal contents indicate that *L. seeberi* feeds primarily on microscopic animal life and vegetable matter dredged from the rocks and bottom sands or mud. Breeding migrations take place and a fine action picture of a leaping *L. seeberi* will be found in Piscator No. 16, page 117. Maturity is reached at a size of about 250 mm.

TYPE SPECIMEN: The type specimen is presumably lost.

Labeo umbratus (A. Smith), 1841. Mud mullet.

Described by Andrew Smith as from "north of the Orange River." The name refers to the mottled appearance of the live fish.

SYNONYMS: *Labeo cafer* Castelnau, 1861.
Labeo sichili Castelnau, 1861.
Labeo stenningi Gilchrist & Thompson, 1913.

Barnard 1943, p. 135; Du Plessis 1963, p. 337.

DESCRIPTION: The scales are small with 53–68 along the lateral line, 26–34 around the caudal peduncle. Head $3\frac{3}{4}$–$4\frac{1}{3}$ times in standard length. Mouth inferior, lips moderately developed with inner surface of both lips covered with numerous small papillae. There are two pairs of barbels on each side of the mouth. Gill rakers fine, 3+15 (young) to 10+32 (adult) on anterior arch. Dorsal fin usually IV 9 but occasionally IV 8 or IV 10, the first spine being very small. Anal fin III 5, caudal deeply forked.

Live specimens are very variable in colour, those taken from muddy water being very pallid with some iridescent pink mottling. The specimen illustrated in colour plate XI, was taken from clear water in the Buffalo River near King William's Town. Specimens preserved in formalin are usually light brown with some darker mottling.

The largest specimen on record is one with a total length of 310 mm.

DISTRIBUTION: Widely distributed in the Gouritz, Gamtoos, Sundays, Bushmans, Fish, Keiskama and Buffalo rivers, as well as the Orange-Vaal system above the Aughrabies Falls. The presence of this species in the Buffalo River, King William's Town, may be due to transportation by anglers who use this fish as bait. It is reported by du Plessis (1963) that *L. umbratus* has escaped into the Olifants River, Limpopo system, from the Tweefontein Dam, near Witbank, where it was introduced by a local angling club in error for *Barbus holubi*.

REMARKS: Intestine long, intestinal contents indicate that *L. umbratus* dredges the bottom muds for microscopic algae and animal life. As this species breeds freely in dams and isolated pools, upstream migration for breeding purposes does not appear essential. *L. umbratus* can tolerate a wide range in conditions both in water temperature and quality of the water. Due to the fact that it multiplies prolifically it is an undesirable species in Municipal Reservoirs as during drought periods large-scale mortalities occur with consequent pollution of the water.

TYPE SPECIMEN: The type specimen has been lost.

Labeo capensis (A. Smith), 1841. Orange River sandfish.

No precise type locality is given in the original description of this species.

SYNONYM: *Labeo tenuirostris* Steindachner, 1894.

The type locality of *L. tenuirostris* must have been incorrectly recorded as the species figured and described is undoubtedly *L. capensis* which has not been found outside the Orange River system.

Barnard 1943, p. 131; Du Plessis 1963, p. 337.

DESCRIPTION: The scales are moderate in size with 42—50 along the lateral line, and 20—22 around the caudal peduncle. Head $3\frac{1}{4}$ $4\frac{3}{4}$ in standard length, mouth inferior with well developed lips fringed with papillae, the inside of the upper lip with transverse rows or plicae of very small papillae. There are two well developed barbels on each side of the mouth. Gill rakers numerous, 3 + 14 (young) to 12 + 38 (adult) on anterior arch. Dorsal fin usually III 11, occasionally III 10, anal III 5, the caudal being deeply forked.

The colour of live specimens varies with condition of the water. The specimen illustrated in colour plate XII was taken from the Vaal River near Kimberley, but large specimens uniformly slate-grey in colour have been seen. The sharp rise of the nape and the compressed head are typical of adult specimens. Young specimens are silvery light grey with dark grey mottlings. Specimens preserved in formalin are uniformly dark grey, or mottled grey with light underparts.

The largest specimen on record is one with a total length of 450 mm.

DISTRIBUTION: Endemic to the Orange-Vaal River system above and below the Aughrabies Falls.

TYPE SPECIMEN: Andrew Smith's type specimen appears to have been lost.

Genus ***Engraulicypris*** Günther, 1893.

Members of this genus, the name meaning "small cyprinid", are very important as food for predatory species. They breed freely and appear in considerable numbers in the waters they inhabit. Their main food consists of planktonic crustaceans, diatoms and algae.

Engraulicypris brevianalis (Boulenger), 1908.

Described from Zululand, Natal, the name refers to the anal fin which, in the case of the type specimen, was shorter than those of other members of this genus.

SYNONYMS: *E. whitei* v. d. Horst, 1934.
E. gariepinus Barnard, 1943.

Fig. 17. *Engraulicypris brevianalis* (Boulenger). Minnow. × 1.5

DESCRIPTION: Lateral line 45–59 scales, 10–11 from origin of dorsal to lateral line, 1 from lateral line to origin of ventral fin, the lateral line dips sharply towards the belly. Caudal peduncle 16 scales. Head $2\frac{1}{3}$–$2\frac{3}{4}$ times in standard length; mouth terminal, oblique, with lower jaw of mature specimens covered with minute tubercles. Gill rakers on anterior arch 9–11. Dorsal II 7, occasionally II 8, anal III 12–17, the dorsal being nearer the caudal than the snout and originating over the origin of the anal fin.

Live specimens are silvery white in colour with a more intense silver lateral stripe in some specimens. In material preserved in formalin a pigmented lateral stripe develops as well as spots above the base of the anal fin and along the dorsal surface.

The largest specimen examined had a fork length of 75 mm. The specimen illustrated in fig. 17 came from the Limpopo River.

DISTRIBUTION: Within the region found in the Orange River only below the Aughrabies Falls. North of the Orange it is common in the Limpopo and rivers south of this down the east coast to as far as the Black Umfolozi River in Natal (Crass 1960, p. 441). North of the Limpopo it has been found in the Kabompo River of the Upper Zambezi system, but is apparently absent from intervening rivers.

REMARKS: Material from the Kabompo River, submitted by Mr. G. Bell-Cross of the Game & Fisheries Department, Zambia, has been examined carefully and cannot be separated from *E. brevianalis* with 14–16 anal rays. From this it was concluded that *E. brevianalis* is a variable species with a cline from east to west in anal ray counts, 12–14 in the former region and 14–17 in the latter, and a wide but discontinuous distribution.

TYPE SPECIMEN: The type of *E. brevianalis* is in the British Museum (Natural History), No. 1907.4.17.90.

Family BAGRIDAE

These are moderately elongate fishes without scales, the dorsal and anal fins being short, the former having a well developed spine. There is an adipose dorsal fin present and there are three or four pairs of unbranched circum-oral barbels.

This is a large and old family which appears to have originated in North Africa or the Oriental Region and dispersed from there. Both Beaufort (1951, pp. 135–136) and Darlington (1957, p. 112) refer to the close relationship between the Bagridae of Africa and Asia and the Pimelodidae of South America.

Genus ***Gephyroglanis*** Boulenger, 1899.

Two endemic species of this genus are isolated in the Orange River basin and the Olifants River, south-west Cape, respectively. The nearest members of this genus are to be found in the Congo River basin. Belonging to the Primary Division of freshwater fishes this is a zoogeographical puzzle as both *G. sclateri* and *G. gilli* are hardy fish with omnivorous feeding habits.

Fig. 18. *Gephyroglanis sclateri* Boulenger. Rock-barbel. — 2·5

Gephyroglanis sclateri Boulenger, 1901. Rock-barbel.

Described from the Orange River and named in honour of Mr. W. L. Sclater, Director of the South African Museum 1896–1906.

Barnard 1943, p. 224.

DESCRIPTION: Moderately elongated, without scales. Dorsal fin short with pronounced spine, I 7, rarely I 8, second dorsal fin adipose. The dorsal fin varies in shape irrespective of age or sex, see fig. 19. In high fins the dorsal spine equals the distance from the hind margin of the opercle to the posterior nostril. The dorsal spine is a little longer or subequal to the pectoral spine, the pectoral spine being strongly serrated on the inner border. Anal fin usually four spines, 2–3 simple rays and 10–12 branched rays. Caudal forked with obtuse lobes. Head smooth, $3\frac{1}{4}$—4 times into standard length. There are four pairs of circum-oral barbels, the nasal barbels being very short. The number of gill rakers increases with size, the average being 4 + 10 in young fish and 6 + 16 in adults.

The colour of live fishes varies from olive brown with mottled dorsal surface to almost black.

G. sclateri is an omnivorous feeder, feeding primarily on aquatic insects, larvae and nymphs. Large specimens take small fish. Nothing is known of its breeding habits. The largest specimen in the South African Museum has a total length of 300 mm.

DISTRIBUTION: Endemic to the Orange and Vaal River systems where it is widely distributed in both warm and cold waters. As suggested by Barnard (1943) the specimen recorded by Gilchrist & Thompson (1913) from the Kafue River, Zambia, was undoubtedly mislabelled. Recent surveys have not revealed the presence of *Gephyroglanis* in Zambian waters (Jackson 1961[*a*]).

TYPE SPECIMEN: Holotype S.A.M. 4708 in the South African Museum, Paratype No. 1901. 2. 11. 23 in the British Museum (Natural History).

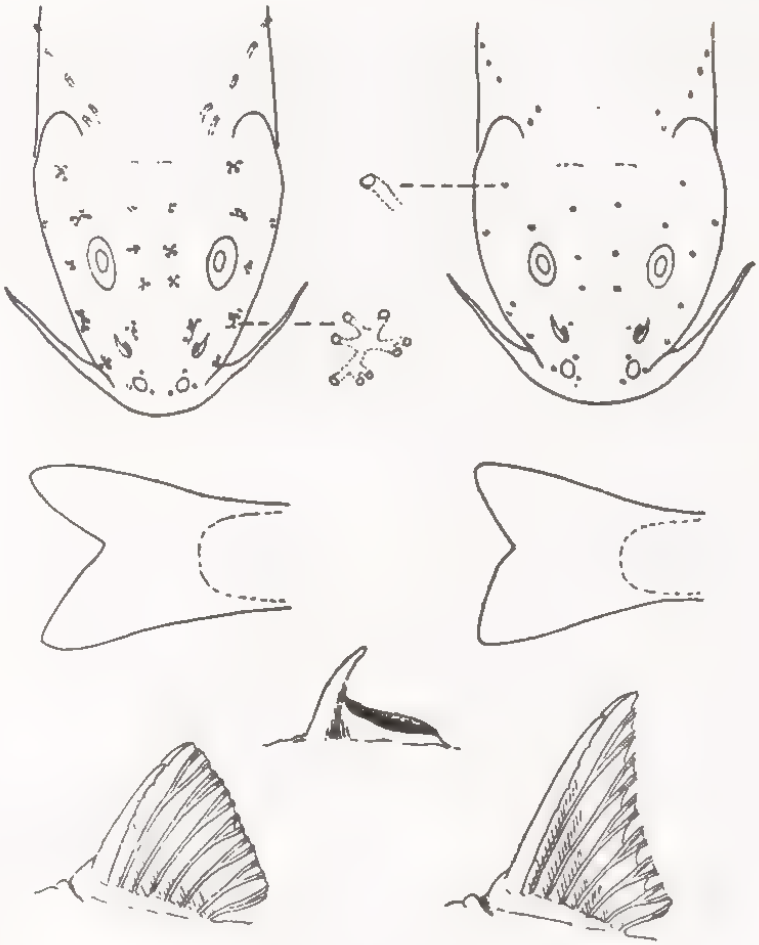


Fig. 19. Dorsal views of head of *Gephyroglanis sclateri* (left) and *G. gilli* (right). Below these are respective caudal fin shapes. Lower diagrams illustrate low and high forms of dorsal fin of *G. gilli* as well as the side view of posterior nostril. (After Barnard).

Gephyroglanis gilli Barnard, 1943. Rock-barbel.

Described from the Olifants River near Clanwilliam and named in honour of Dr. E. L. Gill, Director of the South African Museum 1925–1942.

Barnard 1943, p. 227.

DESCRIPTION: Closely related to *G. sclateri* but differing in the shape of the caudal fin which is not as deeply forked, and has more obtuse caudal lobes, the composition of the anal fin which usually has 3 spines, 2 simple rays and 10 branched rays, as well as certain characteristics of the head. As described by Barnard, when comparing specimens of *G. gilli* with specimens of *G. sclateri* of equal size, the head of *gilli* is relatively larger and the eye smaller. The snout is larger in *gilli*, and the distance between the anterior nostrils is almost twice in snout length in *gilli*, but almost thrice in *sclateri*. The dorsal fin formula is normally I 7 with occasional I 6.

As in *sclateri* the dorsal spine is a little longer than the pectoral spine but, in the low fin form, the two spines are subequal. Barnard (1943) found that the low untorn dorsal fin could be correlated with a placid and muddy habitat, whereas the high ragged fin is correlated with a strong and more turbulent habitat.

Recent collecting has failed to reveal the presence of *G. gilli* in the Olifants River system near Clanwilliam or Citrusdal. Barnard's largest specimen had a total length of 105 mm.

DISTRIBUTION: Endemic to the Olifants River system, south-western Cape.

TYPE SPECIMEN: Syntypes in the South African Museum, Nos. S.A.M. 22467 and S.A.M. 19359.

Family CLARIIDAE

The Clariidae are scaleless elongate fishes with bony, broad, flat heads and long dorsal and anal fins without spines. These fishes have four pairs of unbranched circum-oral barbels or sensory organs. They are widely distributed in Africa, Syria and south-east Asia, being renowned for the fact that most of the genera have accessory breathing organs which enable them to live in water of low oxygen content. (See fig. 22.) In one genus of the Great Lakes of Africa, *Dinotopterus*, these are reduced or absent as they are not necessary, only an empty chamber remaining to show that once their ancestors possessed them.

One genus *Clarias* is represented in the Orange River and the Umtamvuna River.

Genus ***Clarias*** Scopoli, 1777.

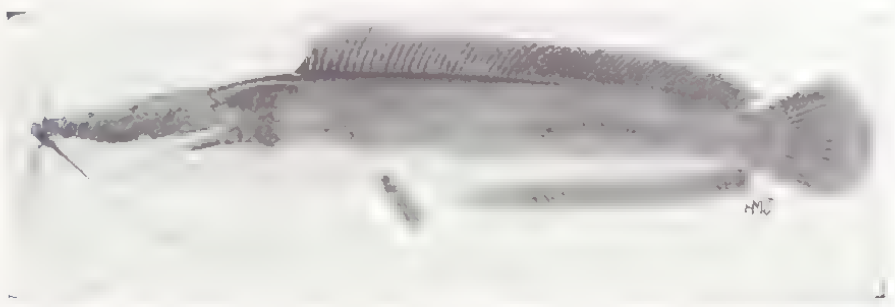


Fig. 20. *Clarias gariepinus* (Burchell) Catfish or barbel. Plain form. × 1/6

Fig. 21. *Clarias gariepinus* (Burchell). Catfish or barbel. Mottled form. × 1/6

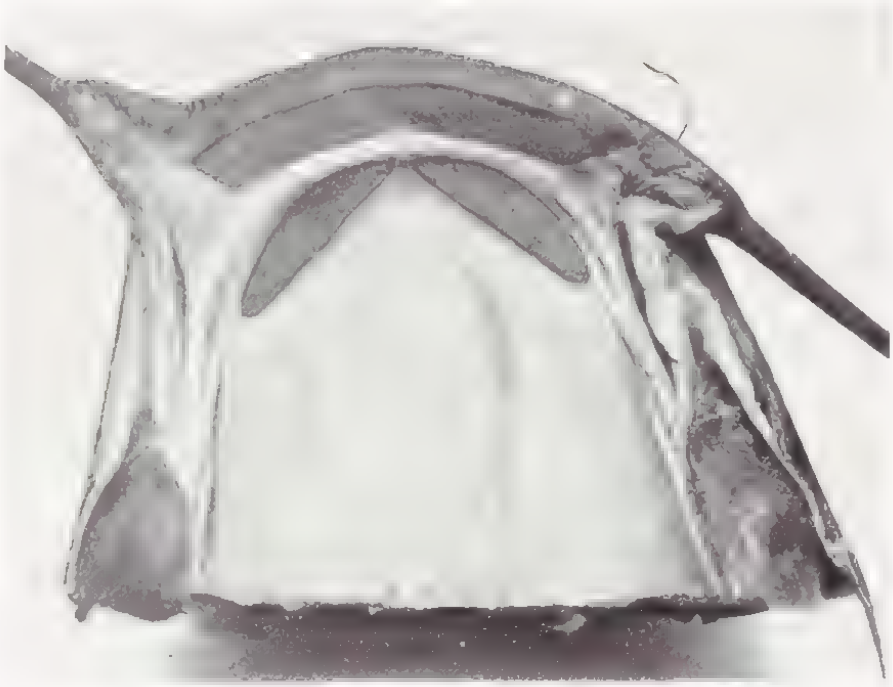


Fig. 22 (*a*). Dentition upper jaw, *C. gariepinus*.

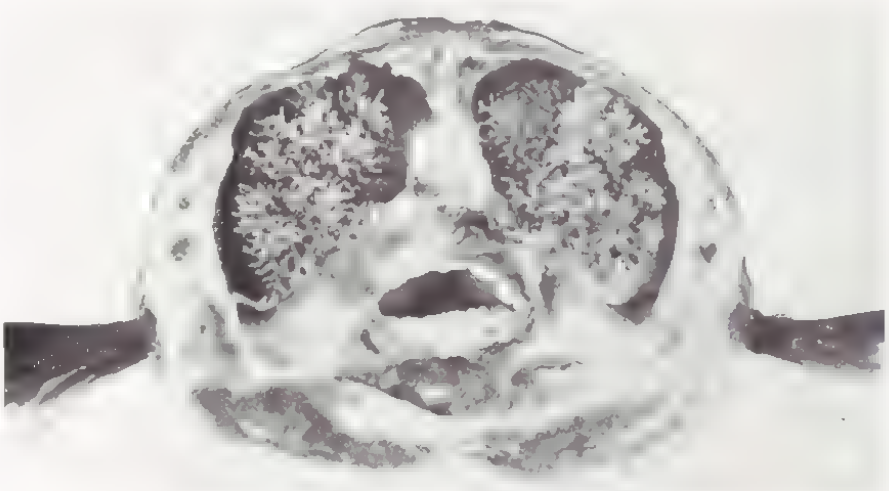


Fig. 22 (*b*). Rear view of dissected head of *C. gariepinus* showing supra-branchial organs and chambers.

Clarias gariepinus (Burchell), 1822. Catfish or barbel.

Described from the Orange River, the name refers to the Hottentot name for the Orange River, "gariep". Burchell's species has been recognised purely on a geographical basis. His description is inadequate but there is no mistaking his illustration for anything else but a *Clarias*. As only one species of *Clarias* has been found in the Orange River system Burchell's name has been adopted.

SYNONYM: *C. capensis* Cuvier & Valenciennes, 1840.

Greenwood 1955, p. 516; Jubb 1961, p. 112.

DESCRIPTION: An elongate depressed fish with no scales. Head broad, flat and bony, its length, measured along dorsal surface from snout tip to posterior point of supra-occipital process, 3–4 times in standard length. The eyes, supero-lateral in position, are relatively small. There are four pairs of circum-oral barbels, a nasal pair situated on the dorsal surface, two long maxillary barbels, and a pair of inner and a pair of outer mandibular barbels. The gill rakers are fine, closely set, with 25 (young) to 75 (adult) on the anterior arch. The vomerine band of teeth (see fig. 22[*a*]) is narrow and equal to, slightly greater or less than the width of the premaxillary band of teeth. Both dorsal and anal fins are long, reaching the caudal peduncle, the former having 62—72 rays, the latter 50—60.

Fish taken from muddy water are olive-grey in colour with light belly but the usual colour is a very dark grey, some almost black, with a white belly. Some specimens are olive-grey mottled with dark grey, (see figs. 20 and 21).

DISTRIBUTION: The Orange River and its northern tributaries, as well as the Umtamvuna River. North of this *C. gariepinus* is widely distributed. In respect to the distribution of the Clariidae it should be noted that Menen's (1951, p. 294) distribution maps for *Heterobranchus* and *Clarias* are incorrect in so far as the southern tip of Africa is concerned. The southerly distribution of the former ceases at the Middle Zambezi system and the Buzi River of Portuguese East Africa, and the latter at the Orange and Umtamvuna rivers.

REMARKS: *C. gariepinus* grows to a great size, the record weight on rod and line being a fish of 65½ lb. taken from the Vaal River. In "Fauna & Flora" No. 12, issued by the Director of Nature Conservation, Pretoria, there is a report on page 49 of a monster of 130 lb. taken from the Vaal River in 1898.

Described as an omnivorous scavenger *C. gariepinus* feeds on practically anything that comes its way. When zooplankton is abundant *C. gariepinus* can be seen feeding at the surface of the water, but it usually feeds at the bottom or in thickly weeded areas. From fish watched feeding in clear water the barbels play an important part in the capture of aquatic vertebrates. The fish remains motionless with all barbles erected in front of the mouth, any animal touching one of these is immediately grabbed.

The suprabranchial organs are well developed (see fig. 22). These elaborate accessory breathing organs in the form of much branched filaments developed from two of the gill arches on each side, enable fishes of this genus to utilise atmospheric oxygen. *Clarias* are thus able to live for long periods, up to about eighteen hours, out of water. During gill-net operations it was found that *C. gariepinus*, prevented from rising to the surface, were drowned. It thus appears that even under good conditions *C. gariepinus*, as well as other members of the genus (Greenwood 1957, p. 66), is dependent upon the additional supply of atmospheric oxygen.

Although *C. gariepinus* can be found in water of low oxygen content, breeding takes place during the summer months in grassy places inundated by flood waters of high oxygen content. *C. gariepinus* in advanced breeding condition have been found migrating into freshly inundated pans. Actual spawning has not been observed but this has been described in detail for the very closely related *C. mossambicus* by Greenwood (1955, p. 516). The eggs, about 2 mm. in diameter, are attached to plants and debris in the water by an adhesive disc. Early development is rapid and the young fishes hatch within thirty-six hours after fertilisation.

Despite their small size larval *Clarias* are remarkably hardy being able to withstand considerable and rapid change in temperature; also they are able to utilise atmospheric oxygen at an early age even though the supra-branchial organs are not fully developed.

The wide dry beds of the Auob and Nossob rivers form perfect roads through the Kalahari Gemsbuck National Park. No surface water has been known in these river beds since 1934, but copious rains in South West Africa brought them down in flood in January 1963. With the flood waters came young *Clarias gariepinus* carried down from the distant highlands where water is more permanent. These young fish could not have come from the Orange River as the Nossob-Auob-Molopo system has been cut off by huge sand dunes which divert any water that may reach the Molopo south of its confluence with the Nossob into the desert at a place known as Abiquas Puts (20 08 E 27 22 S). This diversion is over 1000 years old (Wellington 1955, p. 343) and is of such dimensions as to be completely impossible for even the hardy *Clarias* to cross.

TYPE SPECIMEN: There is no record of a type specimen.

Family ANGUILLIDAE

Genus ***Anguilla*** Shaw, 1803. The freshwater eels.

KEY TO THE *ANGUILLA* SPECIES

A. Skin pattern with distinct mottling; maxillary teeth with longitudinal groove:
  (i) Ano-dorsal value 16—19, vertebral count 106 (103—108):
    A. marmorata page 48
  (ii) Ano-dorsal value 7—14, vertebral count 111 (107—115):
    A. nebulosa labiata page 49

B. Skin with no mottled pattern; maxillary teeth without longitudinal groove:
  (i) Ano-dorsal value 9—17, vertebral count 103 (100—105):
    A. mossambica page 51
  (ii) Ano-dorsal value −1—+5 (short dorsal fin):
    (*a*) Maxillary teeth band very broad; vertebral count 109 (106—115):
      A. bicolor bicolor page 51
    (*b*) Maxillary teeth band narrow; vertebral count 104 (102—107):
      A. obscura page 51

The identification and biology of the *Anguilla* species has been described in some detail in Volume 1 of these Annals (Jubb, 1961). Five species have been discovered in those rivers flowing into the West Indian Ocean. These are the mottled long-finned eel *A. marmorata* Quoy & Gaimard, 1824, the African long-finned mottled eel *A. nebulosa labiata* Peters, 1852, the plain long-finned eel *A. mossambica* Peters, 1852, and the two short-finned eels *A. obscura* Günther, 1871, and *A. bicolor bicolor* McClelland, 1844.

From the study of prevailing sea currents and the arrival of elvers along the east coast of Africa it is concluded that suitable breeding grounds for *Anguilla* species exist in the West Indian Ocean somewhere east of Madagascar. Larval forms of *Anguilla* species found in the West Indian Ocean have been described by Jespersen (1942). The marine larval phase, or phase of passive migration under the influence of ocean currents, is followed by a phase of active migration into fresh water after metamorphosis of larval eels or *Leptocephalus* into young eels or elvers has taken place. The South Equatorial Current, which is deflected by Madagascar to become the southerly Agulhas Current and the northerly East African Coastal Current, carries larval eels towards the coast of Africa where they arrive in distinct zones known as elver zones. The bulk of the elvers of *A. nebulosa labiata* and *A. bicolor bicolor* reach Africa north of Lat. 21 S., and those of *A. mossambica* south of this to as far as Port St. Johns. From this evidence it is assumed that the former two species use the northerly

sector of the hypothetical breeding grounds, their larvae being carried in the northerly periphery of the South Equatorial Current, and that *A. mossambica* uses the southerly sector (see fig. 23). The elvers of *A. marmorata* are known from Madagascar but, as yet, not from the coast of Africa.

The distribution of a particular species inland over a river system has been found to be associated with the size of the eel entering the river, and is not governed by water temperature

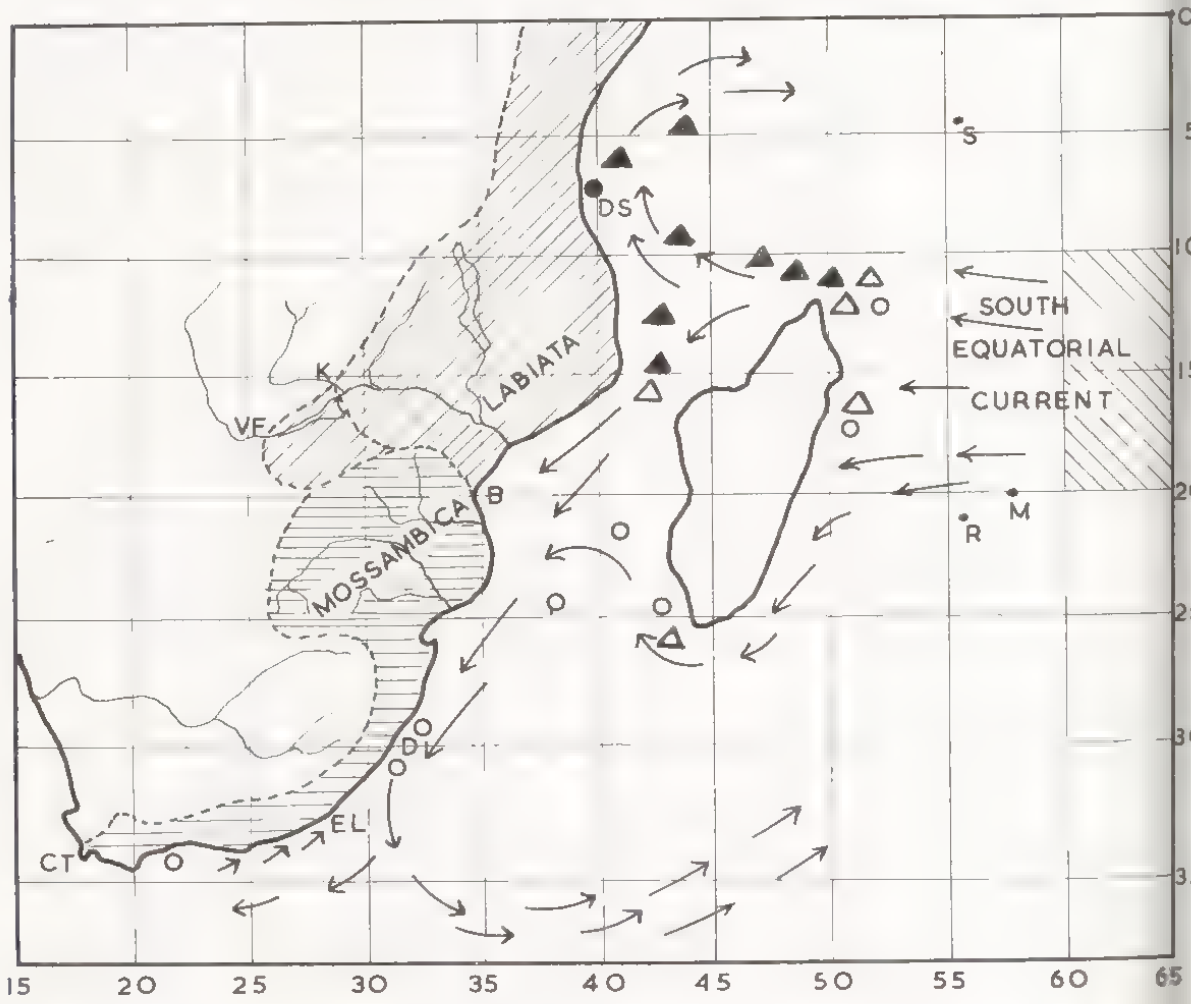


Fig. 23. Western Indian Ocean showing prevailing sea currents during January and February. Hatched areas on land show where *Anguilla nebulosa labiata* or *Anguilla mossambica* is the predominant species. Hatched area on extreme right is the hypothetical breeding ground. Areas where larval eels or elvers have been found are marked thus:

△ *Anguilla marmorata*
● *Anguilla nebulosa labiata*
) *Anguilla mossambica*
▲ *Anguilla bicolor bicolor*

or any particular environment. Thus we find that the deepest penetration inland is made up those rivers whose mouths are situated within the elver zone of a particular species. It is also this species which predominates in this region but, although migrations beyond these elver zones occur the number of eels, particularly males, decreases with distance. No specimens of male *A. marmorata*, *A. nebulosa labiata* or *A. bicolor bicolor* have been found in Cape Province waters.

True elvers reaching the African coast range from 43 61 mm. in length. Secondary migrations outside the elver zones are made by young eels of about 90 120 mm. in length, which, from an examination of their otoliths by Frost and Talbot, prove to be at least a year older than elvers. These older eels, which carry out their migrations with the same vigour and determination as elvers, waterfalls and concrete dam walls being no obstacle, are known as post-elvers. It is these post-elvers which migrate considerable distances beyond known elver zones and are responsible for the wide distribution of eels along the coast of Africa.

South of Port St. Johns no true elvers of any species have been found except for a single specimen of *A. mossambica* from the estuary of the Breede River. Skead's (1959) consistent observations of eel migrations up the Buffalo River, King William's Town, show that only post-elvers, nearly all *A. mossambica*, are involved. Similar migrations have been observed at the Shongweni Dam near Durban, as well as up rivers to the south of this such as the Kariega, Sundays and Kromme. Field work showed that post-elvers were abundant in most rivers to as far west as the Homtini River near Knysna, but nothing smaller than a length of 89 mm. was found. Skead was able to trace anadromous movements to the ebb and flow of the Buffalo River. It is not known where these post-elvers come from but there is ample proof that they make up the major portion of the eel populations of the rivers of the Cape Province. From their appearance and apparent age it would seem that post-elvers collected at the Laing Dam wall, Buffalo River, had been at sea since metamorphosis had taken place. The bulk of these have been found to be *A. mossambica*, but they were usually accompanied by a few larger specimens of *A. marmorata*, *A. nebulosa labiata* and *A. bicolor bicolor*. As the distance from any elver zone increases the fewer become the numbers of eels found in the rivers.

The phase of feeding and growing in fresh water lasts for about 8 years in the case of males, and up to 20 years for females. Up to about 20 cm. in length their diet consists almost entirely of small crustacea, aquatic insects, larvae and nymphs. Then there is a gradual change and the stomach contents of eels of 50 cm. in length and over were found to consist chiefly of *Potamon* and small vertebrates, predominantly Pisces. This feeding and growing phase is followed by a second metamorphosis into a mature eel with enlarged gonads, mature males being considerably smaller than mature females. This second metamorphosis involves a change in the colour of the eel from the yellowish feeding eel into a silver eel with metallic bronze or black dorsal surface and iridescent white belly with very dark pectoral fins. At the same time the eyes become enlarged and the snout very pointed, the former being one of the first external indications of approaching maturity. At this stage the mature eel is known as a silver eel. Once maturity is reached the catadromous migration to the sea begins when the final adult marine phase is entered upon, nothing being known of this phase. Mature male and female *A. mossambica* have been intercepted whilst trying to reach the sea but no specimens have been taken at sea. Silver eels captured at or near river mouths have been found to be feeding, in excellent condition, and with no sign of deterioration of the gut.

Both the anadromous migrations of elvers and post-elvers, and the catadromous migrations of silver eels are associated with the flooding of rivers during the summer rainy season with maximum activity during the months January to April. The first silver eels can be found as early as October but elvers and post-elvers do not put in an appearance in large numbers until early January. It is of interest to note that this period January to April also overlaps that when elvers arrive along the shores of western Europe and Japan, and also

when mature eels leave the rivers of Japan (Matsui, 1957). In Madagascar catadromous migrations of *Anguilla* species have been known for generations, and traditional eel fisheries are operated by local inhabitants in certain areas during the months November to February (Kiener, 1959). Under certain conditions both post-elvers and silver eels make short overland excursions in order to complete their migrations, an essential factor being that moisture is available.

Each year, therefore, elvers and post-elvers reach the east and south coast of Africa in vast numbers. The potential supply of adults from these invasions is governed by the extent of suitable inland waters, their permanency, and amount of food available. Eels soon disappear from rivers which remain dry for years due to drought, or, which carry no water to the sea due to exploitation of the normal flow.

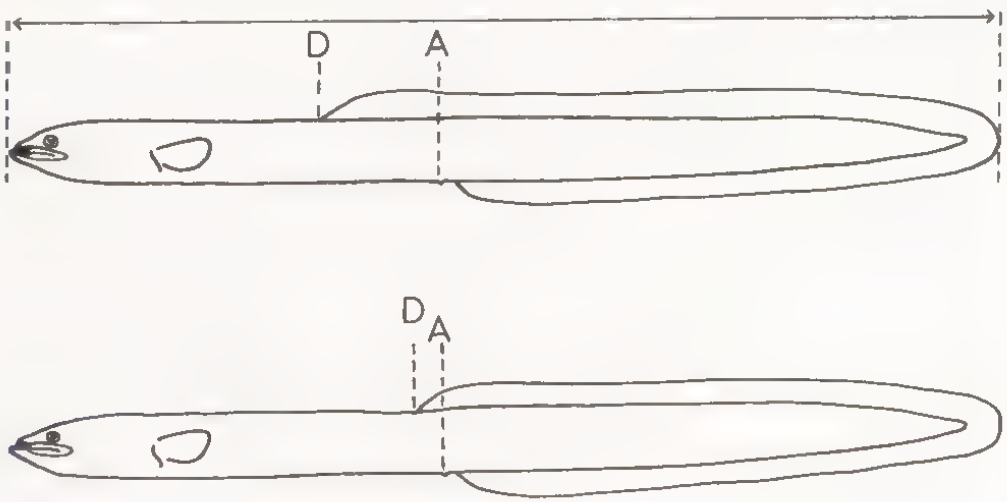


Fig. 24.

Identification of the Species

In the identification of specimens of about 20 cm. in length and over use is made of the skin pattern, dentition pattern, vertebral count and the position of the origin of the dorsal fin in relation to the position of the anus. For this latter evaluation an ano-dorsal value is determined from the following formula AD × 100 L, where L = the total length of the eel and AD = the distance between the verticals through the origin of the dorsal fin and the centre of the anus. A negative ano-dorsal value is obtained when the origin of the dorsal fin is posterior to the anus. (fig. 24.)

Anguilla marmorata Quoy & Gaimard, 1824. Madagascar mottled eel. Bontpaling.

Described from the Waygiou Island, Pacific Ocean. The name refers to its mottled or marbled skin pattern.

Ege 1939, p. 36; Jubb 1961, p. 20.

DESCRIPTION: Although the largest female examined had a length of 135 cm. and a weight of 23 lb. heavier specimens have been reported, but no doubt this species has been confused with the next. The dorsal fin is long, ano-dorsal value 16—19. Vertebral count 106, range 103—108. Maxillary teeth have a distinct longitudinal groove which extends to the posterior end of the band of teeth (see fig. 25 A).

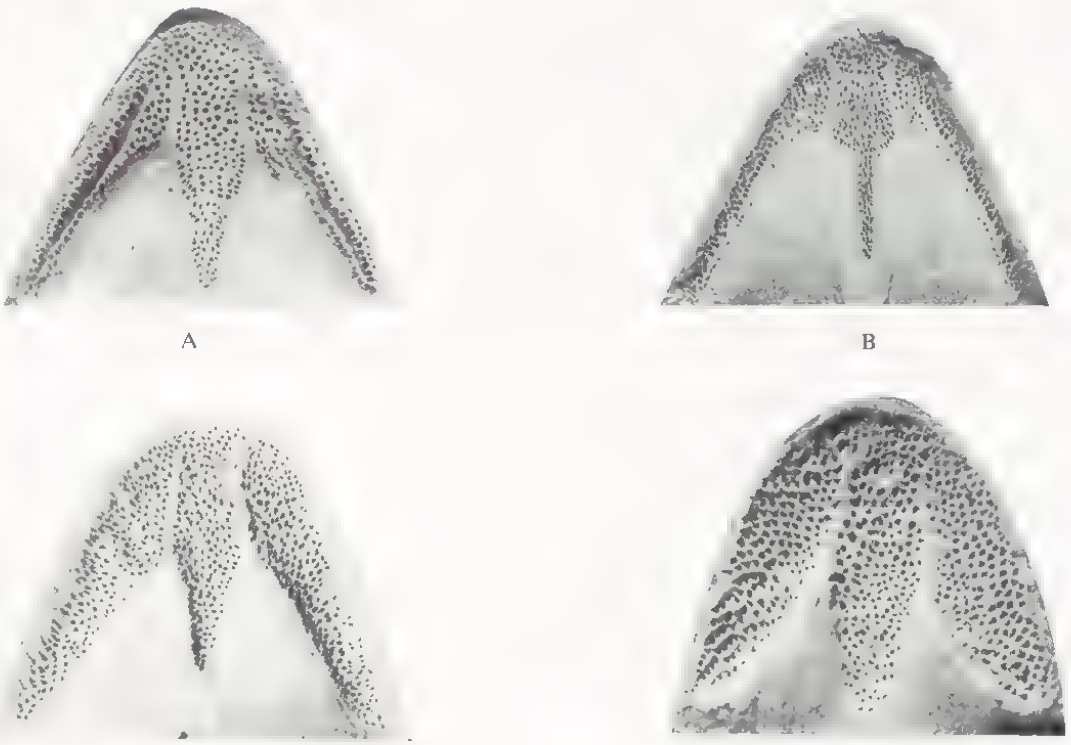


Fig. 25. Dentition Patterns.

The skin has a distinct mottled or marbled pattern. Depending on the turbidity of the water the colour varies from olive-yellow mottled with olive-brown in muddy water, to olive-yellow mottled with dark green-brown in clear water. Mature specimens are very dark on the dorsal surface, the belly being iridescent white. The colour of mature specimens gives rise to the colloquial name of "swartwitpens" paling. The marbled pattern remains after preservation.

DISTRIBUTION: This is an Indo-Pacific species with wide distribution. Although males are known from Madagascar, only females have been found along the African coast where they are common and grow to a great size in the rivers of the Transkei. This species has been found as far south as the Kromme River near Humansdorp.

TYPE SPECIMEN: In the Paris Museum, registered number 4109.

Anguilla nebulosa labiata Peters, 1852. African mottled eel. Bontpaling.

Described from the Zambezi River, Tete, Portuguese East Africa. The name refers to its colour and thick lips.

SYNONYM: *A. macrophthalma* Peters, 1852, a male of the species.

Ege 1939, p. 36; Jubb 1961, p. 23.

DESCRIPTION: This is another large species, the largest examined was a female of 154 cm. with a weight of 22 lb but much heavier eels of this species have been reported. The dorsal fin is medium in length, the ano-dorsal value being 7 14. Vertebral count 111, range 107–115. Maxillary teeth have a longitudinal groove but this does not extend to the hindermost tip of the band of teeth (see fig. 25 B).

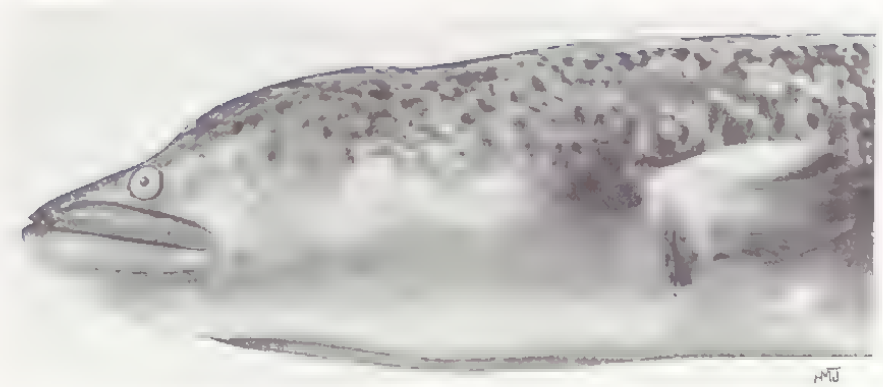


Fig. 26. *Anguilla nebulosa labiata* Peters. African mottled eel. Head of a large female.

The mottled skin pattern is usually bolder than that of *A. marmorata*. Taken from muddy water the colour is olive-yellow mottled with green-brown from the top of the head, along the sides, reaching the ventral surface posterior to the anus. Specimens from rocky clear water are generally darker, being dark olive mottled with dark green-brown. Mature specimens are uniformly dark on the dorsal surface with iridescent white belly. The mottled pattern remains after preservation.

DISTRIBUTION: This is the predominant eel of the Zambezi and rivers north of this. In the rivers of the Cape Province occasional females reach as far west as the Homtini River near Knysna. The remarkable ability of *Anguilla* species to ascend waterfalls is demonstrated by the fact that during 1963 a specimen of *A. nebulosa labiata* was discovered in the Zambezi River above the Victoria Falls. This specimen was collected by the Game Warden, Mr. J. E. Newby, and is in the Rhodes-Livingstone Museum.

REMARKS: Gilchrist & Thompson (1917, p. 467) have listed *A. nebulosa labiata* as a synonym of *A. bengalensis* (Gray), 1830, but Ege (1939 pp. 78–80) has shown that *A. nebulosa labiata* is a sub-species of the Indian eel *A. nebulosa nebulosa* McClelland, 1844.

TYPE SPECIMEN: In the Berlin Museum, Nos. 6227 and 6228. The type of *A. macrophthalma*, No. 6226, is a mature male with enlarged eyes.

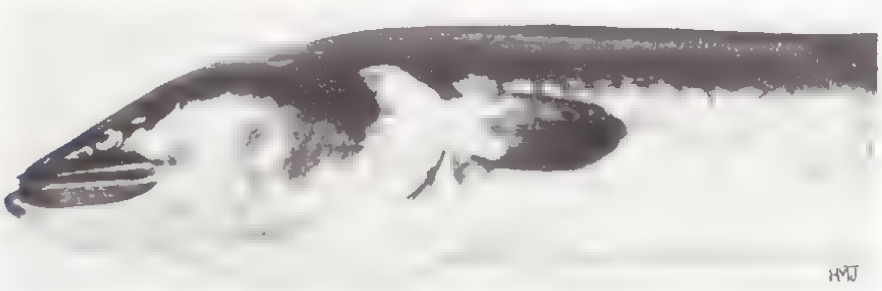


Fig. 27. *Anguilla mossambica* Peters. Plain long-finned eel. A large female from the Kariega River.

Anguilla mossambica Peters, 1852. Plain long-finned eel. Paling.

Described from the Molumbo River, Mozambique, Portuguese East Africa.

SYNONYM: *A. capensis* Kaup, 1859.

Ege 1939, p. 90; Jubb 1961, p. 23.

DESCRIPTION: A smaller species than the previous two, the largest female examined, a silver eel, had a length of 122 cm. and a weight of 10½ lb. The largest mature male had a length of 51·5 cm. The dorsal fin is long, the ano-dorsal value having a range of 9—17. The vertebral count is 103, range 100—105. The maxillary bands of teeth are in several rows without any longitudinal groove (see fig. 25 C).

The skin has no mottled pattern. The colour varies from olive-brown on the dorsal surface in muddy water to dark slate-grey in clear water, the belly being olive-yellow. Mature specimens are dark metallic bronze or black on the dorsal surface with iridescent white belly. Material preserved in formalin is similar in appearance.

DISTRIBUTION: Common in the rivers of the Cape Province to as far west as the Breede River, but as we proceed west of this the number of eels found in the inland waters decreases rapidly. Occasional specimens of *A. mossambica* are taken by anglers in the Orange River system, there being one in the South African Museum from the Caledon River, and four specimens in the Alexander McGregor Memorial Museum, Kimberley, from the Vaal River. These may be young eels that have managed to cross from the Limpopo or Tugela River systems into the Vaal system during floods. On the other hand if, by chance, an eel should round the Cape and reach the mouth of the Orange River, it would have no difficulty, even at a large size, in negotiating one of the many side streams associated with the Aughrabies Falls and by-passing the main falls to reach the Orange River above. It is significant that all the specimens examined from the Orange River have proved to be females.

TYPE SPECIMEN: In the Berlin Museum, registered No. 6230.

Anguilla obscura Günther, 1871. Short-finned eel.

Described from the Fiji Islands. The name refers to its dusky or dark appearance.

Ege 1939, p. 152; Jubb 1961, p. 24.

DESCRIPTION: A small species with short dorsal fin, the ano-dorsal value being 1—5. Maxillary band of teeth narrow with length of intermaxillary-vomerine band of teeth 70—80 per cent of the distance from the front end of this band to the posterior tip of the right maxillary band. Vertebral count 104, range 102—107.

A single specimen 35·5 cm. in length collected on the 8th August, 1957, in a tributary of the Buffalo River, King William's Town, has been assigned to this species. The vertebral count of specimen is 103 and the ano-dorsal value 2·4. It was dark slate in colour with lighter belly. Little change took place in colour after preservation.

DISTRIBUTION: *A. obscura* is a tropical species of the West Pacific Ocean. The specimen taken from the Buffalo River is no doubt a stray, but its presence in the West Indian Ocean does demonstrate the wandering around at sea that takes place on occasions. As a parallel to this Ege (1939, p. 151) quotes six specimens of the European eel, *A. anguilla* from Kenya. These specimens must have entered the Indian Ocean via the Suez Canal.

TYPE SPECIMEN: In the British Museum (Natural History), registered No. 1871.9.13.145.

Anguilla bicolor bicolor McClelland, 1844. Short-finned eel.

Described from the rivers of Bengal, India. The name refers to the coloration of this species.

SYNONYM: *A. virescens* Peters, 1852. Here again reference is made to the natural appearance of the eel.

Ege 1939, p. 151; Jubb 1961, p. 24.

DESCRIPTION: A short-finned eel which does not attain any great size. The largest mature female examined was a specimen 64·0 cm. in length with a weight of 1 lb. 1 oz. The ano-dorsal

value has a range of −1 – +3. The vertebral count is 109 with a range of 106–115. The dentition pattern is quite characteristic, see fig. 25 D, with a broad maxillary band of teeth, the length of the intermaxillary-vomerine band of teeth being 85–95 per cent of the distance from the front end of this band to the posterior tip of the right maxillary band (see fig. 25 D).

Live immature specimens examined have been a pale olive colour on the dorsal surface with very light belly. A single mature female was dark bronze with iridescent white belly, heavily pigmented in places. Material preserved in formalin is much the same in appearance.

DISTRIBUTION: Widely distributed in the Indian Ocean, even reaching the north-west coast of Australia. This is a species of the lowland rivers and is usually found near the sea. In the Cape Province region it is found in all rivers in small numbers to as far west as Knysna.

REMARKS: Gilchrist & Thompson (1917, p. 469) have listed *A. bicolor* as a synonym of *A. australis* Richardson, 1841, but Ege (1939, pp. 203–206) has shown that this is incorrect.

TYPE SPECIMEN: The type of *A. bicolor bicolor* has been lost, but Peters' type of *A. virescens*, registered No. 6229, is in the Berlin Museum.

Identification of small specimens of *Anguilla* less than 20 cm. in length.

Vertebral counts are important when examining young eels, especially those with not fully developed dentition, and, as in the case of young mottled eels, the skin pattern is obscure. The short-finned eel can be recognised by its ano-dorsal value and vertebral count. In the case of long-finned eels the material has to be sorted out in extremes of ano-dorsal values and the material then dissected, stained, cleared and the vertebrae counted under a microscope. There is no difficulty in separating *A. nebulosa labiata* from *A. marmorata* or *A. mossambica* using this method, but some confusion would result between a specimen of *A. marmorata* with a low vertebral count and one of *A. mossambica* with a high count.

Family CICHLIDAE

The family Cichlidae, which belongs to the secondary division of freshwater fishes, is concentrated in the tropics of Africa and America. Cichlidae speciate readily under certain conditions, chiefly lacustrine, but some species have adapted themselves to a wide variety of conditions and are widely distributed. To this latter group belong the three species, which represent the genera *Tilapia* and *Hemihaplochromis*, found in some of the rivers of the Cape Province.

Genus ***Tilapia*** A. Smith, 1840.

The name *Tilapia* is derived from a Bechuana word "thlape" meaning a fish. It would appear that the whole Sotho group uses the same word.

Because of their great economic value as food the *Tilapia* have been studied extensively. The genus, according to breeding habits, has been divided into two main groups, "mouth-brooders" and "sub-stratum spawners" (Lowe, 1959). The former brood young and eggs in their mouths, a duty usually carried out by the female or maternal brooder, but in the case of a few West African species the male or paternal brooder carries out this function. Sub-stratum spawners do not brood in the mouth but both male and female guard the eggs and young. In basic anatomical features it has been found that sub-stratum spawners all have 12 or less gill rakers on the lower part of the anterior arch and coarse pharyngeal teeth, whereas mouth-brooders have from 15 to as many as 28 gill rakers and fine pharyngeal teeth.

Tilapia mossambica Peters, 1852. Mozambique bream.

This species was first described from the Lower Zambezi, Mozambique Territory, Portuguese East Africa.

SYNONYMS: *T. vorax* Pfeffer, 1893.
T. natalensis Weber, 1897.
T. arnoldi Gilchrist & Thompson, 1917.

Mortimer 1960, pp. 63–64; Jubb 1961, pp. 131–132; Whitehead 1962, pp. 605–637.

DESCRIPTION: The Cichlidae have two lateral lines. The lateral line count is made along the top lateral line from the operculum towards the caudal to the end of the pitted scales, the count being continued along the lower lateral line from the scale next to the transverse row from this point. Lateral line 30 scales, range 29–32. Dorsal fin usually XVI 11, range XV–XVII 12—10, anal III 9—10. Gill rakers 16—20 on lower portion of anterior arch, see Fig. 28A. Pharyngeal teeth fine, see Fig. 28B. Teeth in 4–7 series, small and usually conical. Deep and compressed in shape, the males usually develop a pronounced elongated concave snout. Large males attain a weight of up to 6¼ lb.

The colour of live specimens depends a great deal on habitat. There is sexual dimorphism, the males usually being darker in colour with a distinct red or plum-coloured edge to the dorsal and caudal fins. For differences in coloration see colour plates XIII and XIV. During the breeding season males become very dark with red edging to the fins very prominent. Young fish are silvery grey with a series of irregular vertical bars on the sides. During their first year these young fish have a pronounced *Tilapia* mark on the dorsal fin where the soft rays begin. This mark is shown in the colour plate of *Tilapia sparrmanii*. In addition to males being larger than females of the same age group the sexes can be separated by close examination. The female has an oviduct between the anus and the urethra, thus she has three orifices whereas the male has only two.

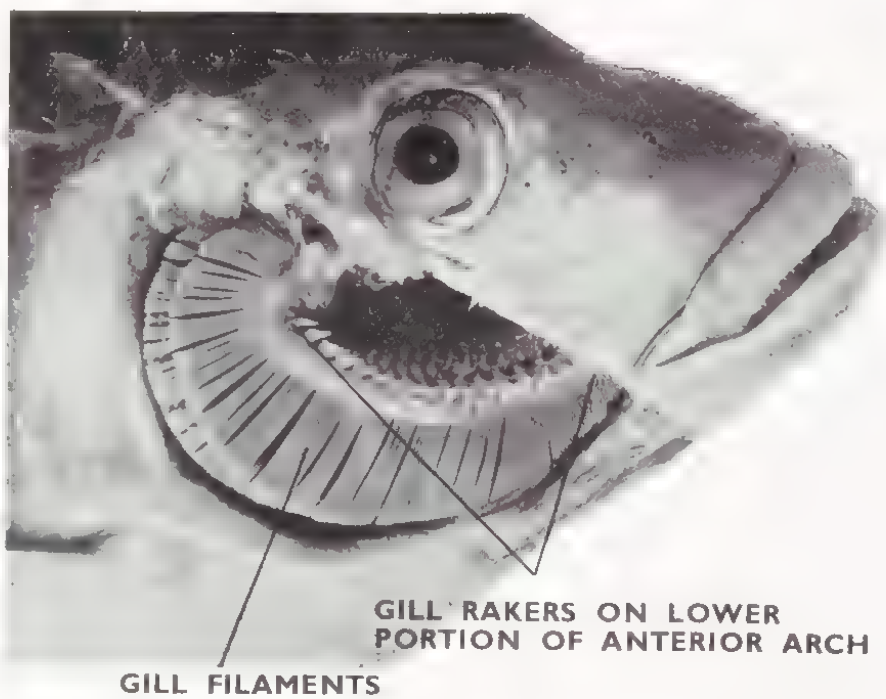


Fig. 28 A. Head of *Tilapia mossambica* showing gill rakers on anterior arch.

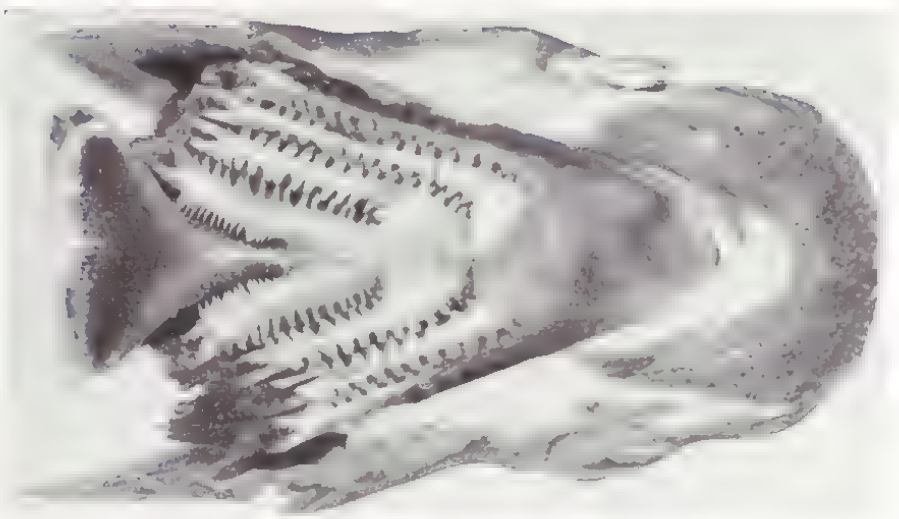


Fig. 28 B. Lower jaw of *Tilapia mossambica* showing pharyngeal teeth (left).

DISTRIBUTION: Found naturally in all the east coast rivers from Kenya to as far south as the Brak River, Long. 26 35'E, Lat. 33 44'S, just south of the Bushmans River. This species has been used extensively in fish culture experiments as well as for the control of mosquito and *Chironomid* larvae in power station cooling tanks. It is now established in the North End Lake, Port Elizabeth, the De Hoop vlei, Bredasdorp, and Princess Vlei, Cape Town. In the former the water is kept at a temperature of 70 -75 F. throughout the winter months as the water is circulated through the local power station for cooling purposes. Mr. Farquharson of the Albany Museum recently found *T. mossambica* in the Gamtoos River system which no doubt originated from introduced stock. Specimens, also from introduced stock, from the Kuiseb River lagoon, South West Africa, have been examined. This remarkable fish has been carried all over the world to serve mankind (Atz, 1954, F.A.O. (United Nations), 1955, 1957).

REMARKS: *T. mossambica* is said to be a euryhaline species as it can withstand a wide range in salinity of the water. It has no difficulty in entering saline estuaries where it is quite common in rivers of the eastern Cape. In both the Bushmans and the neighbouring Kasouga River it has been found living and breeding in water with a salinity of 32‰. The Port Alfred lagoons are full of *T. mossambica*. Very little fresh water ever enters the above estuaries these days, the only replacement being that done by tidal action. Mortimer (1960), in experiments carried out at the Fish Culture Station, Chilanga, near Lusaka, found that *T. mossambica*, originating from the Luangwa River, Middle Zambezi system, could tolerate a gradual increase in salinity up to 26‰, but that some individuals died when the salinity was increased to 35‰. The reverse, however, could be carried out without a gradual change, fish transferred straight from water with a salinity of 32‰ into fresh water of the same temperature survived. This remarkable ability is discussed in some detail, in relation to other fishes, by Black (1957, pp. 163–199).

There is little doubt but that the osmoregulating mechanism of *T. mossambica* has played a big part in its natural dispersal along the east coast of Africa, and that it has moved from estuary to estuary via the sea. It is significant that between the mouth of the Brak River and that of the Sundays, a distance of 45 miles, no rivers enter the sea. This distance is much greater than that between any other river mouths along the east coast.

Another interesting fact is that under saline conditions *T. mossambica* tolerates lower water temperatures than in fresh water. In fresh water the critical temperature for survival of *T. mossambica* has been found to be 50 F., and little development takes place in water of an average temperature of 60 F. In the Bushmans and Kasouga river estuaries the winter average water temperatures are below 60 F., and frequently drop to below 50 F. without signs of distress or mortalities amongst *T. mossambica* populations. In fresh water this species flourishes in water with a summer range in temperature of 70°—80°F.

T. mossambica is a maternal brooder. The male, which develops breeding colours, builds a series of nests in a suitable spawning area, usually still water of three to six feet in depth, with a sandy bottom. Each individual nest is a saucer-shaped depression scooped out of the sand by mouth. It is considered that this operation is the reason for the development of elongated concave-shaped snouts. Each male guards its nests, is polygamous, and fertilises the eggs of females which may move into his area. After a short display the eggs of the female are deposited in one of the depressions where they are fertilised. As soon as this has been carried out the female takes up the eggs into her mouth and moves off to a suitable brooding ground where the eggs are brooded in her buccal cavity. For a while the young return to their mother's mouth at the slightest sign of danger (see frontispiece). Spawning takes place during the summer season when, depending upon conditions, a single female may spawn as many as four times.

Young *T. mossambica* feed mainly on zooplankton (le Roux 1956), but adults are omnivorous to a certain extent as they feed on epiphytic or bottom algae, zooplankton, small crustacea and aquatic insect larvae and worms. Some large adults have been known to feed on small fish.

In spite of its wide distribution *T. mossambica* shows no tendency towards speciation, there being no characteristics by which specimens from the eastern Cape waters can be separated from those of the Zambezi River. It can adapt itself to any habitat where sufficient oxygen is available and the water temperature is suitable, and can be found in rivers, in fresh and saline lagoons, in estuaries and along the shores of lakes. In small enclosed waters it shows a tendency towards breeding rapidly, becoming over-populated, and much stunted in growth. This stunted condition can be remedied by improving living conditions (du Plessis, 1951).

TYPE SPECIMEN: British Museum (Natural History) No. 1861.5.2. 58–59.

Tilapia sparrmanii A. Smith, 1840. Banded bream.

Named from the Hartz River, Orange River system, in honour of Dr. Andrew Sparrman, a Swedish naturalist who visited the Cape 1772–1776.

SYNONYMS: *Chromys moffati* Castelnau, 1861.
T. ovalis Steindachner, 1866. (Not Boulenger 1915, p. 208.)
T. deschauenseei Fowler, 1931.
T. guinasana Trewavas, 1936.

Barnard 1948, p. 449; Jubb 1961, p. 133.

DESCRIPTION: Scales cycloid, lateral line 27–29. Dorsal fin XIII–XV 11–9, anal III 9–10. Gill rakers 9–12 on lower portion of anterior arch. Pharyngeal teeth slightly more coarse than those of *T. mossambica*. Teeth small, in 3–6 series.

The colour of live fishes depends a great deal on habitat and varies from silvery-grey to olive-green with 8–9 vertical dark bars. During the breeding season, November to March, breeding adults become very much darker in colour with 8–9 vertical black bars, two horizontal bars across the snout, and stripes across the forehead and through the eyes. The males add to this with red edging to the dorsal and caudal fins and iridescent blue-green spots on the dorsal and anal fins as shown in colour plate XV. The *Tilapia* spot on the dorsal fin remains prominent for up to three years. Young fish are silvery-grey with 8–9 vertical bars, the *Tilapia* spot being quite distinct in even very young fish.

T. sparrmanii is a small species which attains a total length of 175 mm.

DISTRIBUTION: Its natural distribution in the Cape Province was the Orange River system, but in recent years it has been widely distributed as a forage food for the exotic *Micropterus dolomieu* and *Micropterus salmoides*. *T. sparrmanii* is now established in the Olifants, van Staadens, Kariega and Buffalo rivers. North of the region *T. sparrmanii* is found in the Cunene River, the whole of the Zambezi system, including the Kwando and Okavango rivers, as well as the Limpopo system and rivers south of this to the Tugela in Natal.

REMARKS: *T. sparrmanii* is omnivorous, feeding on aquatic vegetable matter, zooplankton, small crustacea, aquatic insect larvae, nymphs and worms.

It is a sub-stratum spawner with monogamous habits. As the water warms up in spring breeding colours begin to develop and a spawning site is selected. This is closely guarded by the male who frequently displays before the female. Spawning and fertilisation take place in a hollow at the base of a rock or stem of some aquatic plant. The eggs are then diligently guarded and continuously fanned by both adults. On occasions the eggs are picked up in the mouth and moved to another site, but no brooding takes place in the mouth. Du Plessis (1945) found that, after hatching, the young were picked up in the mouth and transferred to a small pit which had previously been constructed in the pond bottom. At the back of the head of the young fish is a marked prominence formed by two pairs of cup-shaped glands which secrete a colourless, sticky substance. This enables the little fish to anchor itself in the pit.

After the yolk-sac has been consumed the young emerge from the pit or hollow and, closely guarded by both parents, they swim around in a shoal feeding on zooplankton. By jerks of their bodies the adults are able to convey signals to the shoal of small fish when danger threatens. Any fish approaching the shoal is immediately attacked by one or other of the parents; even a hand placed in an aquarium containing *T. sparrmanii* guarding their young is attacked.

The illustration accompanying Steindachner's description of *Tilapia ovalis* has the *Tilapia* spot on the dorsal fin and a rounded caudal fin. Boulenger's illustration of *T. ovalis* (1915, p. 208) is not of a *Tilapia* but appears to be a good illustration of *Haplochromis philander* M. Weber, 1897. The caudal of *T. sparrmanii* is usually sub-truncate but specimens with rounded caudals have been examined. This creates a doubt about regarding the 140 mm. specimen of *Chromys moffati* Castelnau, 1861, as representing the very much smaller *Haplochromis philander* also found in the Kuruman River. This latter species rarely exceeds a length of 75 mm., total lengths greater than 100 mm. being unknown. The characteristics of *T. sparrmanii* from the Zambezi system to as far south as the Buffalo River have been examined and it is not possible to separate, allowing for the usual range of differences in widely separated populations of the same species. *T. guinasana* Trewavas, 1936, from *T. sparrmanii*. In addition to this, although now isolated, Lake Guinas, South West Africa, falls within the natural distribution pattern of *T. sparrmanii*. Together with *Clarias gariepinus* and *Haplochromis philander*, *T. sparrmanii* can be found today isolated in the Wondergat near Mafeking, a relict of an ancient river course which linked with the Molopo River.

T. sparrmanii, as is evidenced by its spread in eastern Cape waters, tolerates lower water temperatures than *T. mossambica* but has not been found in saline estuaries.

TYPE SPECIMEN: The type, a skin, is in the British Museum (Natural History), No. 1851.10.26.84.

Introduced **Tilapia.**

Report No. 19 of the Department of Nature Conservation for the year 1962 states that *Tilapia zillii* (Gervais), 1848, *Tilapia nilotica* (Linnaeus), 1757, and *Tilapia galilaea* (Artédi), 1757, were bred at Jonkershoek during the year and distributed to certain impounded waters in the Cape Province.

Young *T. zillii* could quite easily be mistaken for *T. sparrmanii*, particularly as the "*Tilapia*-mark" persists even in adult fishes. The gill raker count is the same, 8 – 12 on the lower portion

of the anterior arch, but the pharyngeal teeth of *T. zillii* are more coarse than those of *T. sparrmanii* of the same size. The lateral line count of the former is higher, being 28—33 as compared with 27—29. Fresh specimens of *T. zillii* have a pink or red flush on the throat and 6—7 dark bars on the sides whereas *T. sparrmanii* has no flush on the throat and 8—9 dark bars. Mature *T. zillii* are particularly red on the throat during the breeding season, *T. sparrmanii* are quite black. The former species, which grows to a much greater size than *T. sparrmanii*, feeds on coarse aquatic vegetation and is therefore a useful pond fish, but it is doubtful if *T. zillii* will survive the low water temperatures experienced during winter.

T. nilotica and *T. galilaea* both have a high gill raker count, 21—28 (Greenwood 1957 [*b*]), which separates them from *T. mossambica* with 16—20 on the lower portion of the anterior arch. Morphologically *T. nilotica* and *T. galilaea* are very similar but adults of the former have numerous dark-red wavy vertical bars on the caudal fin whereas the latter has an unspotted caudal fin. Both *T. nilotica* and *T. galilaea* are mouth-brooders, the females carrying the young, but *T. zillii* is a sub-stratum spawner.

Genus ***Hemihaplochromis*** Wickler, 1963.

Hemihaplochromis philander (M. Weber, 1897). Dwarf bream.

This species was described from Natal. The name probably refers to the polygamous tendencies of the male which is very beautiful in his breeding dress.

SYNONYMS: *Haplochromis moffati* (non-Castelnau) Boulenger 1907, 1915.
Tilapia ovalis (non-Steindachner) Boulenger, 1899, 1915.
Jubb, 1961, page 143.

DESCRIPTION: Scales finely denticulate, lateral line 27—30. Dorsal XIII—XV 11—9, anal III 8—9. Mouth large, oblique with 3—4 series of small teeth. Pharyngeal teeth coarse for the size of the fish, with individual teeth along centre and top of the pharyngeal bone much enlarged. Gill rakers short and thick, 8—10 on the lower portion of the anterior arch.

This is a small species which rarely exceeds a total length of 100 mm. The shape of the body, very rounded caudal, coarse pharyngeal teeth, thick gill rakers and lack of a *Tilapia* spot on the dorsal fin all help to separate this species from *Tilapia* of an equal size. There is marked sexual dimorphism in size and colour, the males being larger and most colourful when in breeding dress as illustrated in colour plate No. XVI. Females and young males are silvery grey with 8—10 vertical bars.

DISTRIBUTION: Confined to the northern tributaries of the Orange River system within the region but widely distributed north of this.

REMARKS: In previous literature this species has been referred to as *Haplochromis moffati* (Castelnau, 1861). Castelnau's inadequate description contains nothing of importance beyond the fact that his specimen was 140 mm. in length and had a rounded caudal fin. These characteristics fit *Tilapia sparrmanii* which is known to inhabit the Kuruman River, the type locality of Castelnau's *moffati*.

H. philander is a mouth brooder, breeding taking place during the summer months November to March. The male constructs a saucer-shaped nest in the sandy bottom by scooping sand in his mouth and then forcibly spewing it out. This nest is guarded against intruders but there is much displaying before any female of the species that may wander towards it. Spawning females are led to the nest where spawning and fertilisation takes place. The eggs are taken into the mouth by the female who then moves off to near the surface of the water where brooding takes place. The young feed on zooplankton near the bottom. Whilst still small they are taken back into the mother's mouth when danger threatens.

Adults are predatory in feeding habits taking small fish, crustacea, and aquatic insect larvae. These fish will rise and take a hovering insect at the surface. Small molluscs moving on the sand are also taken, the shell being spewed out after crunching.

TYPE SPECIMEN: The type specimen is believed to have been lost. Paratypes are housed in the British Museum, registered No. 1935.3.21.1–2.

Family ANABANTIDAE

The ancestral Anabantid form seems to have invaded Africa from Asia during the Upper Eocene (Liem 1963). It differentiated into the genus *Ctenopoma* which invaded most of tropical Africa, whereas in Asia it gave rise to *Anabas* as well as three specialised Asian families. *Sandelia*, as shown by Liem, has in turn evolved from *Ctenopoma*, a group of hardy tropical fish equipped with suprabranchial organs which enable them to survive in poorly oxygenated water. In *Sandelia*, which does not have to live under such austere conditions, one of the features distinguishing it from *Ctenopoma* is the simplified form of the suprabranchial organ (Barnard 1943, p. 246). See fig. 29.

Genus ***Sandelia*** Castelnau, 1861.

This genus was named by Castelnau after Sandeli, Chief of the Gaika branch of the Xosa, 1820–1878.

The presence of *Sandelia*, which belongs to the primary division of freshwater fishes, completely isolated in the southern tip of Africa is another zoogeographical puzzle. The nearest relative is *Ctenopoma multispinis* which is common in the Lake Ngami and Okavango region. The ancestor of *Sandelia*, whether it invaded the South Coastal drainage basin east or west of the Basutoland highlands, would have encountered suitable habitats and environments where it could have survived. However, even in the Zambezi River system there is a marked discontinuity in the distribution of *Ctenopoma multispinis* which, although common in the Upper Zambezi system and parts of the Lower Zambezi system, has not been found in any of the rivers of the Middle Zambezi.

Sandelia are compressed deep fishes with long spinous dorsal and anal fins, split lateral lines and two nostrils on each side of the head. They differ from *Ctenopoma* in having much simplified suprabranchial organs and a non-serrated sub-operculum. The long anal fin with its 6–8 spines enables *Sandelia* to be separated from *Tilapia* with which it is now found in some rivers.

Sandelia capensis (Cuvier & Valenciennes, 1831). Cape kurper.

The name refers to the Cape of Good Hope.

SYNONYM: *Anabas vicinus* Boulenger, 1916.

Barnard 1943, pp. 247–253; Harrison 1952 (*c*), pp. 82—91; Siegfried 1963.

DESCRIPTION: Scales ctenoid, lateral line 26–28 (counted along the lower lateral line from the last pitted scale on the caudal peduncle to the operculum), origin of dorsal to upper lateral line 3–4, with 9–11 scales from upper lateral line to the origin of the anal fin. Caudal peduncle 18 scales, 14–16 in young specimens. Dorsal long, XII—XIV 10–8, anal fin VI–VIII 11—8.

In shape this species can be very variable, especially amongst large specimens (Barnard 1943, p. 250). The specimen illustrated in colour plate XVII, came from the Witte River, Breede River system, the water being very clear at the time. Specimens taken from the Goukamma River, Knysna, van Staadens and the Elands River (Zwartkops River system) were found to be slightly darker in colour, but specimens taken from muddy water were pale olive.

The largest specimen on record is one of 215 mm. total length from Princess Vlei, Cape Flats.

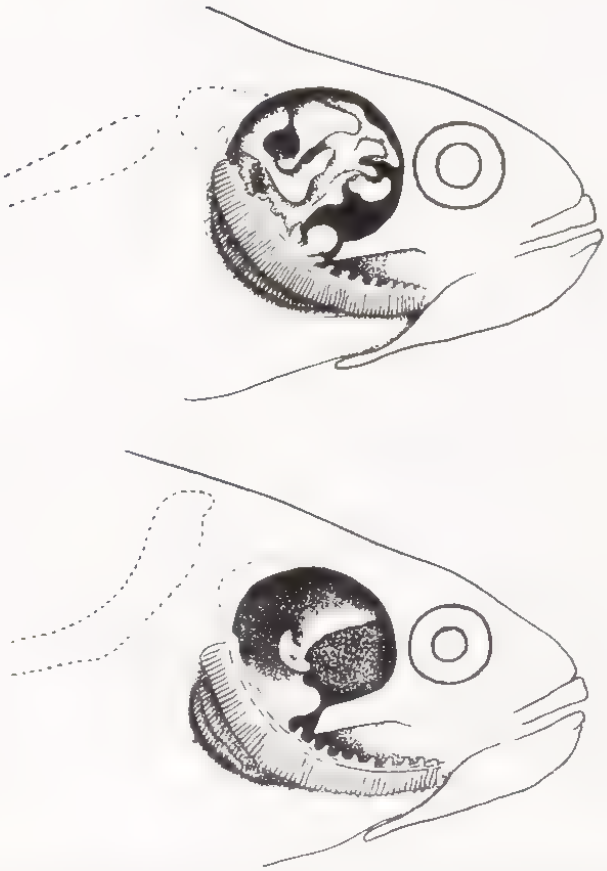


Fig. 29. Suprabranchial organ of *Ctenopoma* (upper) and simplified form of *Sandelia* (lower). (After Barnard).

DISTRIBUTION: Confined to the South Coastal drainage basin from the Langevlei River, Long. 18 20′E, Lat. 32 12′S, to the Coega River, Long. 25 41′E, Lat. 33 48′S. This distribution is continuous, a noteworthy fact being that it is completely absent from the Olifants River. It is also absent from the Sundays River although red-fin *Barbus* are found in the Wit River, a tributary. Distribution in the Gouritz River is not homogeneous, nor in the Gamtoos, *S. capensis* being absent from the Karroo tributaries. In the Elands River (Zwartkops) system small *S. capensis* were found in the mountains near the headwaters of many tributaries.

REMARKS: *S. capensis* is an omnivorous feeder, its main food being aquatic insects, larvae and nymphs. Small fish have been taken from the stomachs of large specimens.

Males and females become mature during their first year, the smallest mating female that has been examined being one of 52 mm. standard length (Siegfried 1963). Spawning occurs during spring and early summer in shallow, quiet water, no nest being prepared. The spawning act is relatively simple and is accomplished during a whirling embrace when milt and ova are extruded by the respective sexes. The eggs sink and adhere to any object they touch. The male then remains in the spawning area and guards the eggs (Harrison 1952, Siegfried 1963). Harrison also observed that during spawning males assume a much darker colour.

In those rivers stocked with black bass, *M. salmoides*, and rainbow trout, *S. gairdneri*, *S. capensis*, unlike the small indigenous *Barbus*, can still be found in fair numbers. However, the *S. capensis* population of Paarde Vlei, a lake of some 133 acres near Cape Town, has been completely exterminated by *M. salmoides* introduced in 1930.

S. capensis tolerates an extremely wide variety of water conditions both physical and chemical. The accessory breathing organ enables it to survive under most unfavourable conditions whether the water be warm, stagnant or muddy. To demonstrate the hardiness of this species Harrison (1952[*c*]) allowed some adults to dry out on a mid-summer day. After some hours the fish appeared dry and lifeless but quickly recovered on being replaced in the water.

TYPE SPECIMEN: In the Paris Museum. The type of *A. vicinus* is in the British Museum (Natural History), No. 1891.5.6. 6–8.

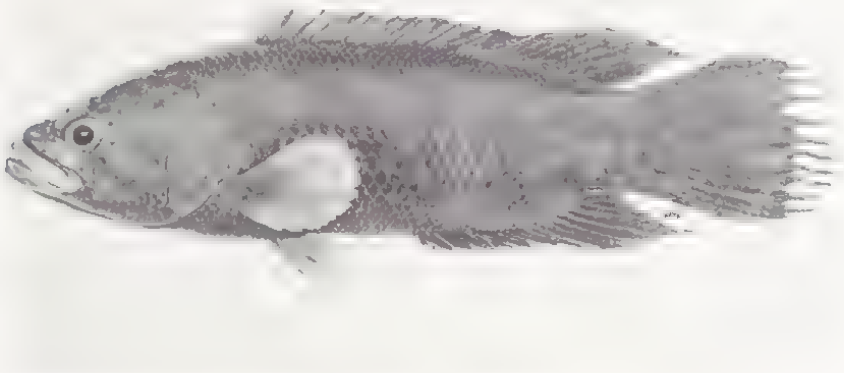


Fig. 30. *Sandelia bainsii* Castelnau. Rockey. × 2/3

Sandelia bainsii Castelnau, 1861. Rockey.

Described from the Kowie River, Grahamstown, and named in honour of the well known geologist, A. G. Bain.

SYNONYM: *Cetenopoma microlepidotum* Günther, 1861.

Barnard 1943, p. 253; Harrison 1952(*c*), p. 90.

DESCRIPTION: Scales ctenoid, lateral line counted along lower lateral line to the operculum, 30–32, origin of dorsal to upper lateral line 6–7, upper lateral line to origin of anal fin 10–12. Caudal peduncle 22, young specimens 20. The opercular spines are distinctly more acute than in *capensis*. Dorsal XV–XVII 10–9, anal fin VII–VIII 10–9.

Live fish are, in general, much darker than *S. capensis*, being a dark green colour with occasional olive green scales along the sides. Specimens preserved in formalin are very dark in colour.

The largest specimen examined had a total length of 200 mm.

DISTRIBUTION: Found in the Kowie River but not in adjacent rivers such as the Bushmans, Kariega, Fish and Keiskama rivers. It then occurs in the Buffalo River, King William's Town, and the Nahoon River near East London.

REMARKS: *S. bainsii* is an omnivorous feeder, large specimens being avid predators on small fish.

TYPE SPECIMEN: The type specimen has been lost.

Family GOBIIDAE

This is a large family of fishes, most of them small, which live along the coast of tropical and temperate seas. Some species enter and live in fresh water, only those found far inland being listed here. Two genera, *Platygobius* and *Glossogobius* are represented. They are easily distinguished from freshwater species found in the region by the fact that their ventral fins are united to form a sucker-like disc, see fig. 31. The species themselves are separated by their longitudinal scale counts, *Platygobius aeneofuscus* having 58–65 scales, and *Glossogobius giuris* having 30–35 scales.

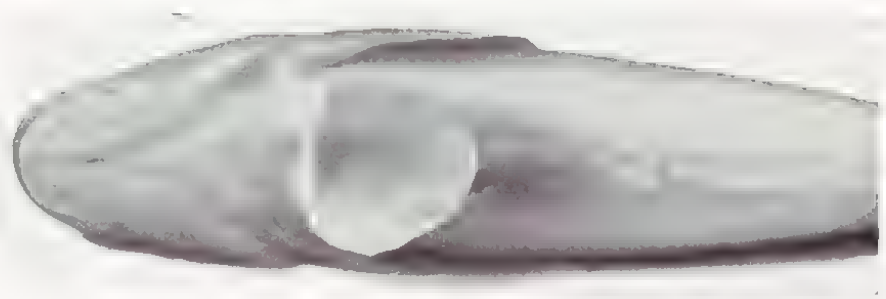


Fig. 31. Ventral fin of *Platygobius*.

Genus ***Platygobius*** Bleeker, 1874.

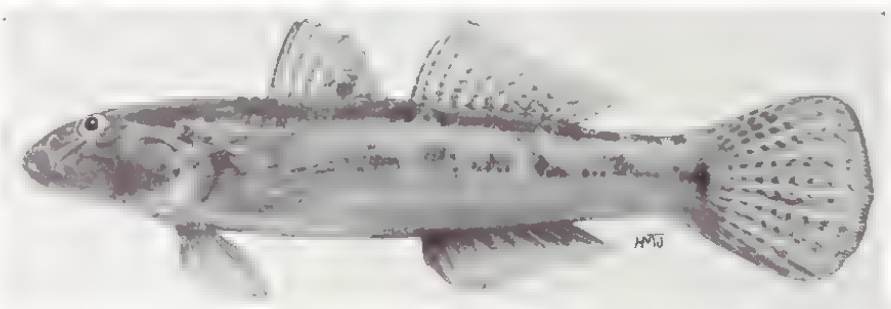


Fig. 32. *Platygobius aeneofuscus* (Peters). Goby. × ½

Platygobius aeneofuscus (Peters), 1852.

Originally described as *Gobius aeneofuscus* by Peters from the Lower Zambezi River. The name, meaning bronze-brown, refers to one of the many colour variations of this species.

J. L. B. Smith 1960, p. 301; Jubb 1961, p. 146.

DESCRIPTION: Scales ciliated, 58–65 in longitudinal series, 18–24 in transverse series from dorsal to anal fin. Head $3\frac{1}{3}$–$3\frac{2}{3}$ in standard length. Mouth slightly sub-inferior. Dorsal fin VI + I 10–11, anal fin I 10–11, caudal rounded. Ventral fins united to form a sucker-like disc. Opercle with no scales.

Live colours blend with habitat and hence are variable. A live specimen taken from the Nuanetsi River, Limpopo system, was silvery white on the belly with dark grey-brown dorsal surface and lateral markings, the dorsal and caudal fins having numerous dark spots. There was a red blotch on the posterior portion of the first dorsal fin.

P. aeneofuscus is reported as attaining a total length of 250 mm.

DISTRIBUTION: Enters the fresh waters of some east coast rivers but is not nearly as common as the next species, *Glossogobius giuris*. *P. aeneofuscus* has not been found inland along the south coast.

TYPE SPECIMEN: In the Berlin Museum. According to Boulenger (1916) one of the types is in the British Museum (Natural History).

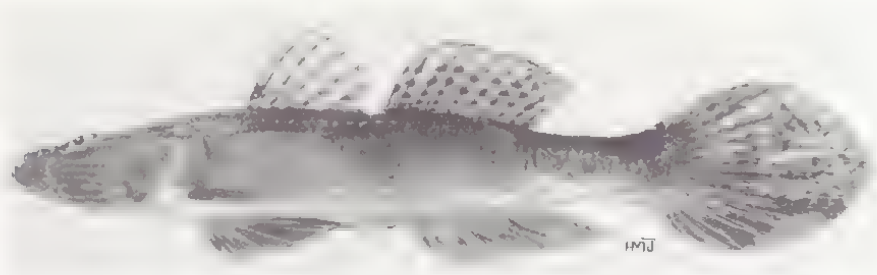


Fig. 33. *Glossogobius giuris* (Hamilton-Buchanan). Goby. × ½

Genus ***Glossogobius*** Gill, 1862.

Glossogobius giuris (Hamilton & Buchanan), 1822. Goby.

Described from the Ganges River, India.

SYNONYMS: *Gobius gulosus* J. L. B. Smith, 1936.
Gobius callidus J. L. B. Smith, 1937.

Barnard 1943, p. 260; J. L. B. Smith 1960, p. 311.

DESCRIPTION: Scales ciliated, 30–35 in longitudinal series, 9–12 in transverse series between dorsal and anal fin. The ventral fins are joined to form a sucker-like disc. The shape of the caudal fin varies a great deal, ranging from rounded to pointed when fully extended. The head is broad and flat with lower jaw projecting, in length it goes 3–3⅓ times in standard length. Dorsal VI + I 8—10, anal fin I 7—8.

The live colours are very variable as they blend in with the surroundings. Specimens in shallow water over sand can barely be detected. Taken from deeper water they are usually speckled dark brown on the dorsal surface with lateral brown markings and light olive ventral surface, the dorsal, caudal and pectoral fin membranes being spotted. The specimen illustrated, fig. 33, was taken in the Sabi River approximately 200 miles inland.

Although the largest specimen collected in the Wit River, a tributary of the Sundays River, had a total length of 150 mm. specimens of 300 mm. were found to be quite common in the Sabi River, Southern Rhodesia.

DISTRIBUTION: Collected in fresh water in all rivers from the Kromme eastwards.

REMARKS: Large specimens are predatory in feeding habits, cannibalism being quite common. From the size of specimens taken from the Wit River it is evident that *G. giuris* can breed in fresh water. At the time of the visit the Wit River was cut off from the Sundays River by a very high concrete dam wall which had been erected several years previously.

TYPE SPECIMEN: There is no record of the type specimen.

EXOTIC FRESHWATER FISHES

Family SALMONIDAE

To this family belong the exotic trout that have been introduced with some success into most of the colder non-acid streams of the South Coastal drainage basin. They are easily distinguished from other fishes of the region by their very small scales and the presence of a small posterior adipose dorsal fin.

Genus ***Salmo*** Linnaeus, 1758.

Fig. 34. *Salmo trutta* Linnaeus. Brown trout. × 1/3

Salmo trutta Linnaeus, 1758. Brown trout.

The name means a trout.

DESCRIPTION: Scales very small, about 110–120 along the lateral line. Head 3¾–4 times in standard length. Vomerine teeth well developed with teeth on the shaft of the bone. Dorsal IV 9–11, anal III 7–8, both fins without spines. Dorsal fin originates well in advance of the ventral fin. The adipose dorsal fin is relatively large as compared with that of the next species.

Live fish are olive brown in colour with black dots on the sides and dorsal fin. There are a few red spots with a bluish halo on the sides, and red spots on the adipose fin.

Harrison (1963) reports that in October 1903 a male weighing 17 lb. was killed at the Pirie Hatchery, King William's Town.

DISTRIBUTION: *S. trutta* was first introduced into the Cape Province in 1892 and subsequently placed in suitable trout waters.

Salmo gairdneri Richardson, 1836. Rainbow trout.

Harrison 1963, pp. 9—14.

DESCRIPTION: Scales very small, about 140 along the lateral line. Head 3¾–4 times in standard length. Mouth large, vomerine teeth being well developed with teeth on the shaft of the bone. Dorsal fin IV 10, anal III 10, no spines in either fin, the origin of the dorsal fin is slightly ahead of that of the ventral. The adipose dorsal fin is small.

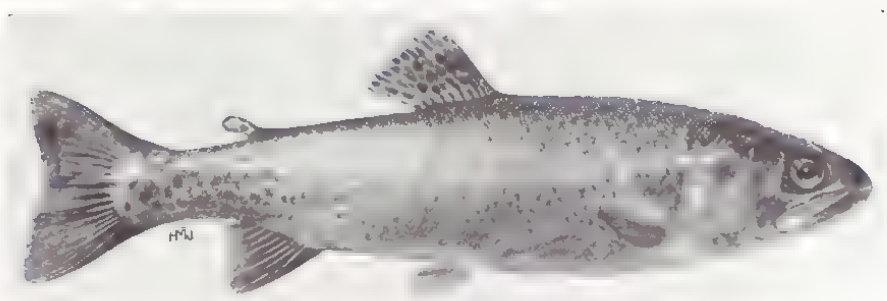


Fig. 35. *Salmo gairdneri* Richardson. Rainbow trout. × 1/3

Live fish taken from fresh water are olive brown with numerous black spots on the sides, dorsal and caudal fins. There is a broad iridescent reddish-mauve lateral band which extends from the caudal to the operculum. The sea-going tendency of *S. gairdneri* has been proved in False Bay (Harrison 1963), and such fish are very silvery in colour with blue-green dorsal surface and a few dark spots on sides, dorsal and caudal fins. Young fish in fresh water are silvery grey, heavily spotted with faint vertical bars.

As recorded by Harrison (1963) in May 1958 a female of 12 lb. 3⅝ oz. was taken from a private lake in East Griqualand.

DISTRIBUTION: *S. gairdneri* was first introduced into the Cape Province in 1897. Fry were reared at Jonkershoek and Pirie hatcheries and subsequently distributed to suitable waters all over the Cape Province.

REMARKS: In many streams *S. gairdneri* has been found to predate heavily on small indigenous *Barbus*.

Fig. 36. *Salvelinus fontinalis* (Mitchell). Brook trout. × 1/3

Genus ***Salvelinus*** Richardson, 1836.

Salvelinus fontinalis (Mitchell), 1815. Brook trout.

The name means a small salmon of the springs.

DESCRIPTION: Scales very small, about 200 along the lateral line. Head 3¾ -4½ times in standard length. The mouth is large, the vomer having no teeth on the shaft. Dorsal fin IV 9 10, anal III 9 11, origin of the dorsal distinctly anterior to the origin of the ventral fin. Adipose fin relatively small.

Live fish are very dark in colour. The dorsal fin has black or dark grey vermiculations on a lighter background, the body being heavily spotted with large spots of a lighter colour. Above and below the lateral line there are some spots, red, orange or yellow, surrounded by a pale sky-blue halo. Juveniles have a series of large spots along the dorsal surface with 6—8 broad vertical bars.

DISTRIBUTION: First introduced to the Jonkershoek Hatchery in 1950 and subsequently distributed to certain suitable waters in the south-western Cape and the Eastern Province. There is, as yet, no proof that this species has become established.

Family CENTRARCHIDAE

Sunfish family

Genus ***Micropterus*** Lacépède, 1802.

The notched dorsal fin and continuous lateral line help to distinguish *Micropterus* from *Tilapia*, *Haplochromis* or *Sandelia*. The generic name means small fins.

Micropterus dolomieui Lacépède, 1802. Smallmouth bass.

Harrison 1963, p. 16.

DESCRIPTION: Scales small, 68 –81 along lateral line with 14—18 scales on the cheek from margin of the eye to angle of preopercle. Dorsal fin not deeply notched, IX +I 12 14, anal fin III 9—11. Posterior extremity of the maxillary does not extend backwards beyond a vertical through posterior margin of the eye. There are small scales on the bases of the membranes of the dorsal and anal fins.

The specimen illustrated, colour plate XVIII, was taken from the Olifants River, Clanwilliam. In young fish the vertical bars are more distinct, the caudal fin having a broad dark band across it. Fingerlings are silvery with numerous spots.

DISTRIBUTION: *M. dolomieui* has become established in the Olifants (Clanwilliam), Berg and Breede Rivers of the south-west Cape, as well as the Umtata River in the Transkei. These populations originated from fish imported by the Jonkershoek Hatchery, Stellenbosch, from the State Hatchery, Limestown, Maryland, U.S.A., in 1937.

REMARKS: In November 1959 this species was found to be breeding above the Bulshoek Barrage, Olifants River, where shoals of fry were seen and sampled. Spawning takes place in nests in shallow water where the male guards the eggs and fry until they shoal.

A detailed survey of the Jan Diesel's River, a tributary which joins the Olifants at Clanwilliam, was made in a search for the small red-fin *Barbus*, but, as far as it was possible to proceed up the river it was found that *M. dolomieui*, an avid predator, had taken possession of the stream. The water was low and no species of any other fish could be found.

A closely related species, *Micropterus punctulatus* (Rafinesque), imported from the United States in 1939, has not become established but this species does occur in the Buffalo River, King William's Town. This is a smaller species than either *M. dolomieui* or the next species *M. salmoides*. In colouring it resembles the latter but has more cheek scales, and, as in *M. dolomieui*, the posterior extremity of the maxillary does not extend backwards beyond a vertical through the posterior margin of the eye. The membranes of the dorsal and anal fins are both scaled. Specimens of up to 1 lb. 6 oz. have been taken (Piscator No. 30, p. 39). In suitable waters *M. dolomieui* attains a weight of 6 lb.

Micropterus salmoides (Lacépède,) 1802. Largemouth bass.

The name refers to its small fins and resemblance to a salmon.

DESCRIPTION: Scales 58 69 along lateral line with 9 12 on the cheek from the margin

of the eye to the angle of the preopercle. The posterior extremity of the maxillary extends backwards beyond a vertical through the posterior margin of the eye. Dorsal fin deeply notched, VIII–IX – I 12–13, anal fin III 9–11. There are no scales on the bases of the membranes of the dorsal and anal fins.

The specimen illustrated, colour plate XIX, came from the Buffalo River, King William's Town. Young fish are silvery grey in colour with a broken heavily pigmented lateral stripe.

Under good conditions *M. salmoides* attains a weight of 8 lb.

Breeding occurs during spring. Spawning takes place in a depression or nest constructed by the male in shallow water. The male continues to guard the nest and young until they shoal.

DISTRIBUTION: *M. salmoides* was first introduced to the Jonkershoek Hatchery via Holland in 1928. Descendants of this stock have since been widely distributed as fingerlings. In some cases the water proved unsuitable but *M. salmoides* is now established in Paarde Vlei (Somerset West) and Groenvlei (Knysna), as well as in rivers such as the Kaffirkuils, Kromme, van Staadens, Elands, Swartkops, Wit, Kariega, Buffalo and Kubusie. Many catchment dams have been stocked with *M. salmoides* and escapes from these may lead to a more general distribution.

REMARKS: *M. salmoides* is an avid predator and where it has become established populations of small indigenous fishes are becoming depleted.

Genus ***Lepomis*** Rafinesque, 1819.

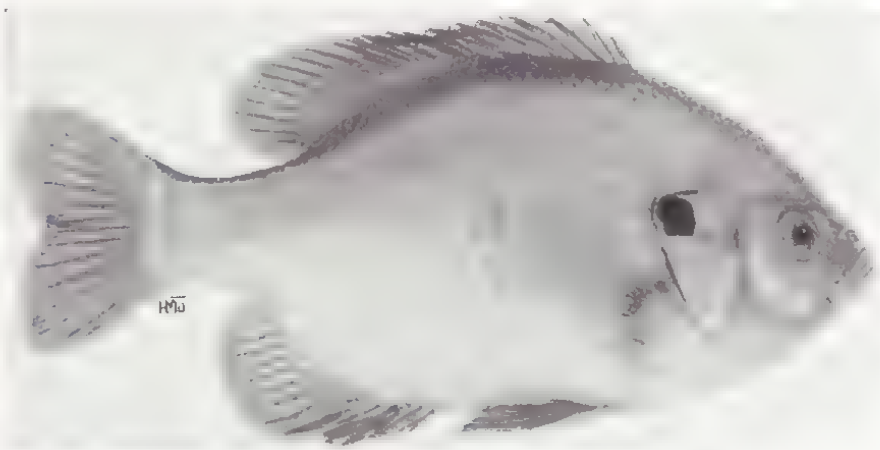


Fig. 37. *Lepomis macrochirus* Rafinesque. Bluegill. · ½

Lepomis macrochirus Rafinesque, 1819. Bluegill.

The name refers to its scaly gill cover and large pectoral fins.

DESCRIPTION: Scales 38–48 along lateral line. Dorsal not notched, X 10–11, anal fin III 10–12. Opercular bone extended with distinct dark membranous flap. Gill rakers long and slender, 8–10 on the lower portion of the anterior arch. *L. macrochirus* is distinguished from *Tilapia* by its single lateral line and general rounded shape.

Large specimens are olive-green on the dorsal surface with iridescent colours on the sides, the belly being pale olive. Small specimens are silvery grey in colour with darker vertical bars on the sides. The "ear flap" is black, the lower portion of the gill cover being iridescent blue.

Weights of up to 2 lb. have been recorded but in most populations fish seldom reach a quarter of this size.

REMARKS: Originally introduced as a forage food for *M. salmoides* this fish is now found in all those rivers which were stocked. It tolerates a wide range in water conditions, breeds prolifically and consequently has become overpopulated in most waters where it is established. Its predatory habits make it a menace to more desirable species, but, like the common carp, *L. macrochirus* has come to stay.

Family CYPRINIDAE

Genus ***Cyprinus*** Linnaeus, 1758.

Fig. 38. *Cyprinus carpio* Linnaeus. Mirror carp. × 1/5

Cyprinus carpio Linnaeus, 1758. Carp, King or Mirror Carp, Leather carp.

The name means a kind of a carp.

DESCRIPTION: There are three forms of carp within the region which come under the same scientific name:

(i) Wild carp or full-scale carp which is a neat looking fish with its regular scales.

(ii) Mirror or king carp which has extraordinary large and irregular scales as shown in Fig. 38.

(iii) Leather carp, which has a few large scales along the back and a thick, soft leathery skin.

Where applicable the lateral line scale count is 35—39, dorsal to lateral line 5—6, lateral line to origin of ventral 5—6, and caudal peduncle usually 14 scales with occasional 12. Head 3½—4 times in standard length, mouth terminal, lips well developed with a pair of maxillary barbels on each side of the mouth. Dorsal long, III 17—22, anal fin III 6, the third spine in both dorsal and anal fins being much enlarged, bony and serrated on the posterior edge. Occasionally mutant forms with a dolphin-like head are encountered (see fig. 39).

Taken from clear water carp are an olive-brown colour along the dorsal surface with pale underparts, the lower caudal lobe, anal and ventral fin being pinkish, but those taken from

Fig. 39. Head of mutant form of *Cyprinus carpio*.

muddy water are generally much paler in colour. In some juvenile specimens the fins have a red or orange tinge to them.

Carp attain an average weight of about 50 lb. but the world's heaviest carp came from the Bon Accord Dam, Pretoria. This fish, which was collected by Mr. R. W. Harris, weighed 83 lb. 8 oz.

DISTRIBUTION: Introduced into the Cape in 1896 the carp is now widely distributed in the Orange-Vaal River system, and is found in the lower reaches of the Berg, Breede, Gouritz, Kromme, Gamtoos, Swartkops, Sundays, Fish, Keiskama, Buffalo, Nahoon, Kei and Umtata rivers.

REMARKS: As will be seen from the wide distribution listed above carp have taken possession of most of the major rivers. They tolerate a wide range in water conditions and their feeding habits tend to made natural waters very muddy. Because of this, and the fact that they breed prolifically and crowd out more desirable fishes, the introduction of carp into uninfested waters is prohibited by legislation.

Carp feed primarily on aquatic insects and vegetation. A great deal of time is spent on dredging the bottom muds for small molluscs and other animal life.

Genus ***Tinca*** Linnaeus, 1758.

Tinca tinca Linnaeus, 1758. European tench. *Tinca* means a tench.

SYNONYM: *T. vulgaris* Cuvier.

DESCRIPTION: Scales very small, about 95—110 along the lateral line. Head $3\frac{3}{4}$ -4 times in standard length, mouth terminal with a single maxillary barbel on each side. Dorsal fin III 8—9, anal fin III 6 7, origin of the dorsal slightly posterior to the origin of the ventral fin.

Fig. 40. *Tinca tinca* Linnaeus. European tench. × 1/3 (By courtesy of Otto Schindler, Kosmos-Naturführer 'Unsere Süsswasserfische'.)

The colour varies from deep olive-green to a dark green-brown with lighter underparts.

In Europe this species is said to attain a weight of about 8 lb.

DISTRIBUTION: *T. tinca* was first imported in 1910 and then distributed to some Cape waters. It has not become a popular fish but small numbers are issued from Jonkershoek Hatchery. In 1953, for example, 1,787 tench were issued for stocking purposes in the Cape Province (Report No. 10, Department of Nature Conservation).

REMARKS: Tench feed on aquatic vegetation, bottom muds, worms, insects and their larvae, as well as shell-fish and snails.

Family PERCIDAE

Perch family

Genus ***Perca*** Linnaeus, 1758.

Perca fluviatilis Linnaeus, 1758. European perch.

Translated the name means a perch of the rivers.

DESCRIPTION: Scales small 58–68 along the lateral line, dorsal fin to lateral line 7–9, lateral line to origin of ventral 13–15. This species can be recognised by its split dorsal fin, the anterior dorsal fin having XIII–XVII spines, the posterior mostly soft rays with I–II 13–15. The ventral fins are in the thoracic position and have a pronounced spine.

Live fish are dark olive-green on the dorsal surface, the sides and belly having about 6 vertical bars. The ventral, anal and lower lobe of the caudal are orange towards their extremities.

Perch attain a weight of about 2 lb. on the average but weights of up to 5 lb. have been taken from Paarde Vlei near Somerset West.

DISTRIBUTION: *P. fluviatilis* was first successfully imported in 1915 but was very slow in

becoming established at Jonkershoek Hatchery. In 1928 this species was introduced into Paarde Vlei where it is still found.

REMARKS: This fish is omnivorous in feeding habits, large specimens being mild predators.

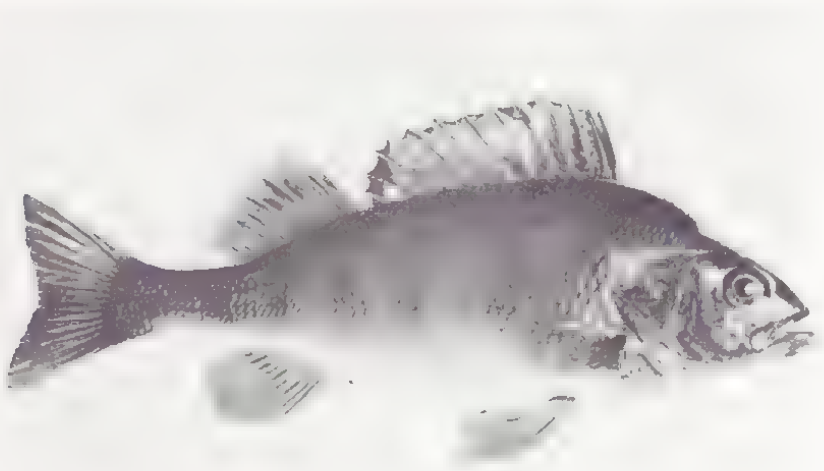


Fig. 41. *Perca fluviatilis* Linnaeus. European perch. × 1/3 (By courtesy of Otto Schindler, Kosmos Naturführer 'Unsere Süsswasserfische'.)

REFERENCES

(For dates prior to 1916 consult Boulenger 1909—1916.)

ATZ, J. W., 1954: 'The peregrinating *Tilapia*', *Animal Kingdom*, **57**, (5), 148–155.

BARNARD, K. H., 1937: 'Note on the identity of the Cape Whitefish, *Barbus capensis*', *Ann. Mag. Nat. Hist.*, (10), **19**, 304–306.

BARNARD, K. H., 1938: 'Notes on the species of *Barbus* from the Cape Province with descriptions of new species', *Ann. Mag. Nat. Hist.*, (11), **2**, 80–88.

BARNARD, K. H., 1943: 'Revision of the indigenous freshwater fishes of the S.W. Cape region', *Ann. S. Afr. Mus.*, **36**, (2), 101–262.

BARNARD, K. H., 1948: 'Report on a collection of fishes from the Okavango River with notes on Zambezi fishes', *Ann. S. Afr. Mus.*, **36**, (5), 407–458.

BEAUFORT, L. F., 1951: 'Zoogeography of the land and inland waters'. Sidwick & Jackson Ltd., London.

BLACK, V. S., 1957: 'The physiology of fishes'. Academic Press, New York.

BOULENGER, G. A., 1909–1916: 'Catalogue of the freshwater fishes of Africa', **1-4**, British Museum (Natural History), London.

CRASS, R. S., 1960: 'Notes on the freshwater fishes of Natal with descriptions of four new species', *Ann. Natal Mus.*, **14**, (3), 405–458.

CRASS, R. S., 1964: 'Freshwater Fishes of Natal'. Shuter & Shooter, Pietermaritzburg.

DARLINGTON, P. J., 1957: 'Zoogeography'. John Wiley & Sons, New York.

DU PLESSIS, S. S., 1945: 'Observations on the habits of *Tilapia sparrmanii*', *Prov. Adm., Cape of Good Hope, Inland Fish. Rept.* 2.

DU PLESSIS, S. S., 1951: 'Stunted fish and pygmyism', *S. Afr. Journ. Sc.*, **47**, 286.

DU PLESSIS, S. S., 1963: 'Revision of the genus *Labeo* (Pisces, Cyprinidae) in the Transvaal, with a description of a new species', *Ann. Transvaal Mus.*, **24**, (4), 327–337.

EGE, VILH, 1939: 'Revision of the genus *Anguilla Shaw*', *Dana Rept.* 16, Copenhagen.

F.A.O. FISHERIES BULLETIN, 1955: 'Tilapia and its culture', Food and Agr. Org., United Nations, Rome, **7**, (1), 1–33.

F.A.O. FISHERIES BULLETIN, 1957: 'The Tilapias and their culture', Food and Agr. Org., United Nations, Rome, **10**, (1), 1–24.

GILCHRIST, J. D. F. & THOMPSON, W. W., 1913 and 1917: 'The freshwater fishes of South Africa', *Ann. S. Afr. Mus.*, **11**, 321–579.

GREENWOOD, P. H., 1955: 'Reproduction in the cat-fish, *Clarias mossambicus* Peters', *Nature*, **176**, 516.

GREENWOOD, P. H., 1957 (*a*): 'Fishes of Uganda—III', *Uganda Journ.*, **21**, (1).

GREENWOOD, P. H., 1957 (*b*): 'Fishes of Uganda—IV', *Uganda Journ.*, **21**, (2).

GREENWOOD, P. H., 1962: 'A revision of certain *Barbus* (Pisces, Cyprinidae) from east, central and south Africa', *Bull. Brit. Mus. (Nat. Hist.)*, **8**, (4), 153–208.

GROENEWALD, A. A. v J., 1958: 'A revision of the genera *Barbus* and *Varicorhinus* (Pisces, Cyprinidae) in Transvaal', *Ann. Transvaal Mus.*, **23**, (3), 263–330.

HARRISON, A. C., 1952 (*a*): 'Cape Galaxias', *Journ. Cape Pis. Soc.*, **22**, 50–54.

HARRISON, A. C., 1952 (*b*): 'The Cape Witvis', *Journ. Cape Pis. Soc.*, **21**, 25–26.

HARRISON, A. C., 1952 (*c*): 'The Cape kurper', *Journ. Cape Pis. Soc.*, **23**, 82–91.

HARRISON, A. C., 1963: 'Freshwater fish and fishing in Africa'. Thomas Nelson & Sons (Africa) (Pty) Ltd., Johannesburg.

HOWELL, F. C. & BOURLIERE, F., 1964: 'African ecology and human evolution', *Viking Series*, 36, 650, Werner-Gren Foundation, New York.

JACKSON, P. B. N., 1961 (*a*): 'The fishes of Northern Rhodesia', Govt. Printer, Lusaka, Zambia.

JACKSON, P. B. N., 1961 (*b*): 'Check list of the fishes of Nyasaland', *Occ. Pap. Nat. Mus. S. Rhodesia*, 25B, Vol. **3**, 535–621.

JESPERSEN, P., 1942: 'Indo-Pacific Leptocephalids of the genus Anguilla', *Dana Report* 22, Copenhagen.

JUBB, R. A., 1959: 'The plump red-fin (rooivlerke) *Barbus asper* Boulenger, 1911', *Journ. Cape Pis. Soc.*, **45**, 34–35.

JUBB, R. A., 1961 (*a*): 'The freshwater eels (*Anguilla* spp.) of southern Africa. An introduction to their identification and biology', *Ann. Cape Prov. Mus.*, **1**, 15–48.

JUBB, R. A., 1961 (*b*): 'An illustrated guide to the freshwater fishes of the Zambezi River'. Stuart Manning, Bulawayo, Rhodesia.

JUBB, R. A., 1963: 'A revised list of the freshwater fishes of southern Africa', *Ann. Cape Prov. Mus.*, **3**, 5–39.

JUBB, R. A., 1964: 'Freshwater fishes and drainage basins', *S. Afr. Journ. Sc.*, **60**, 17–21.

JUBB, R. A. & FARQUHARSON, F. L., 1965: 'The freshwater fishes of the Orange River drainage basin', S. Afr. Journ. Sc. **61**, 118-124.

KIENER, A., 1963: 'Poissons, pêche et pisciculture a Madagascar', *Publication No.* 24 *du Centre Technique Forestier Tropical*, Tananarive.

LE ROUX, P. J., 1956: 'Feeding habits of the young of four species of *Tilapia*', *S. Afr. Journ. Sc.*, **53**, 33.
LIEM, K. F., 1963: 'The comparative osteology and phylogeny of the Anabantoidei (Teleostei, Pisces)', *Illinois Biological Monographs* 30, University of Illinois Press, Urbana.
LOWE, R. H. (MCCONNELL), 1959: 'Breeding behaviour patterns and ecological differences between *Tilapia* species and their significance for evolution within the genus *Tilapia* (Pisces, Cichlidae)', *Proc. Zool. Soc. London*, **132**, (1), 1–30.
MATSUI, ISAO, 1957: 'Records of *Leptocephalus* and catadromous eels of *Anguilla japonica*', *Journ. Shimonoseki Coll. Fish.*, **7**, 151–167.
MENON, A. G., 1951: 'Distribution of Clariid fishes and its significance in zoogeographical studies', *Proc. Nat. Inst. Sc. India*, **17**, (4), 291–299.
MORTIMER, M. A. E., 1960: 'Notes on the salinity tolerations of certain *Tilapia* species in Northern Rhodesia', *Joint Fish. Res. Org. Report No.* 10, Govt. Printer, Lusaka.
MYERS, G. S., 1938: 'Freshwater fishes and West Indian Zoogeography', *Ann. Report Smith. Inst. for* 1937, 339–364.
MYERS, G. S., 1949: 'Salt-tolerance of freshwater fish groups in relation to zoogeographical problems', *Bijdr. Dierkunde* (*Leiden*), **28**, 315–322.
MYERS, G. S., 1951: 'Freshwater fishes and East Indian zoogeography', *Stanford Ichth. Bull.*, **4**, 11–21.
SIEGFRIED, W. R., 1963: 'Observations on the reproduction and feeding of the Cape kurper *Sandelia capensis* in de Hoop lake, Bredasdorp', Prov. Adm. Cape of Good Hope, *Dept. Nat. Cons. Inv. Report No.* 3.
SKEAD, C. J., 1959: 'The climbing of juvenile eels', *Journ. Cape Pis. Soc.*, **46**, 74–86.
SMITH, J. L. B., 1936: 'New Gobioid and Cyprinid fishes from South Africa', *Trans. Roy. Soc. S. Afr.*, **24**, 47–55.
SMITH, J. L. B., 1937: 'Freshwater fishes of the eastern Cape Province', in *Guide to the vertebrate fauna of the Eastern Province*, Pt. 2, Albany Museum, Grahamstown.
SMITH, J. L. B., 1960: 'Fishes of the family Gobiidae in South Africa', *Ichthy Bull. No.* 18, Rhodes University, Grahamstown.
SMITH, J. L. B., 1961: 'The sea fishes of southern Africa', 4th Ed., Central News Agency, Cape Town.
TREWAVAS, E., 1936: 'Dr. Karl Jordan's expedition to South West Africa and Angola—the freshwater fishes', *Novit. Zool. Tring.*, **40**, 63–74.
VAN DER HORST, C. J., 1934: 'Two new fishes from Transvaal', *Ann. Transvaal Mus.*, **15**, (3), 281–282.
WHITEHEAD, P. J. P., 1962: 'The relationship between *Tilapia nigra* (Günther) and *T. mossambica* Peters in the eastern rivers of Kenya', *Proc. Zool. Soc. London*, **138**, (4), 605–637.
WICKLER, W., 1963: 'Zur Klassifikation der Cichlidae, am Beispiel der Gattungen *Tropheus*, *Petrochromis*, *Haplochromis* und *Hemihaplochromis* n.gen.', *Senckenbergiana biol.*, **44** (2), 83–96.